

New Scientist

WEEKLY 31 August 2024

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MPOX BECOMING A
GLOBAL PANDEMIC?

THE SURPRISING
TRUTH ABOUT ONLINE
PROPAGANDA

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USING NOTHING

ERADICATING DEMENTIA

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Feed your brain

Your brain is the hungriest organ in your body, requiring a constant supply of energy and nutrients to remain healthy and function optimally. So what happens to it when you don't get enough to eat? And, most importantly, what should you be eating to keep it fuelled up correctly, asks psychologist Kimberley Wilson. Find out on 12 October at New Scientist Live, online or in person at London's ExCeL Centre.

newscientist.com/nslmag

Tour

Alfred Nobel's Stockholm: Sweden

Join *New Scientist* reporter Alex Wilkins on a walking tour of Stockholm, home of luminaries like Alfred Nobel, Carl Linnaeus and Jöns Jacob Berzelius, whose contributions to botany, astronomy, physics, chemistry and medicine are second to none. Discover the fascinating history of the Nobel prizes on this six-day tour, starting in September 2025.

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Podcast

Weekly

In the latest episode, the team discuss how more people in a coma are aware of their surroundings than we thought. Plus, a mysterious case of ocean cooling, how AI could replace programmers and we may finally have an explanation for the famous Wow! signal from space. Is it aliens? You'll have to listen to find out.

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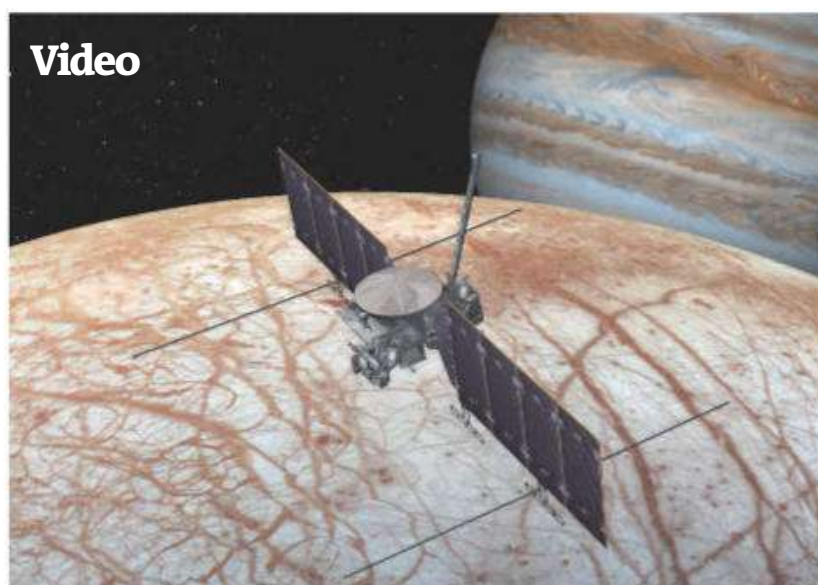
Tour



VIACHESLAV SAVITSKY/SHUTTERSTOCK

Alfred Nobel's Stockholm Soak up the sights in Sweden's capital

Video



NASA/JPL-CALTECH

Search for life NASA's Europa Clipper mission will visit Jupiter's moon

Video

Oceans beyond Earth

NASA's Europa Clipper spacecraft – set to launch in October – will perform dozens of close flybys of Jupiter's moon Europa, gathering measurements to understand the nature of its ice shell and the ocean beneath. Watch this interview with mission scientist Sam Howell and find out how the mission can help us assess the chance there could be life elsewhere in the cosmos.

youtube.com/newscientist

Newsletter

Fix the Planet

Hydrogen is often described as the champagne of the energy transition – expensive and only for special occasions. But huge parts of the economy will need to rely on the fuel. Madeleine Cuff looks at the race to create what might be called the prosecco of the energy transition: cheap, green hydrogen with just as much sparkle.

newscientist.com/fix

Newsletter

“It is impossible to run a net-zero world without quite a lot of green hydrogen”



Essential guide

Tools such as ChatGPT have put artificial intelligence on front pages around the world. So why has AI leapt forwards so suddenly? How can generative AI tools help you? And will this tech lead to human extinction? Get the lowdown on all this and more in our new *Essential Guide*, on sale now.

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'Brightling'



Despite its 10.95mm height, the Trident C60 Pro 300 'Lumière' leaps from your wrist. (Just like it jumped off this page.) Its brightness results from proudly protruding indices and the logo they encircle. Featuring facets finely machined to tolerances of 0.03mm, these mini-monoliths are super-legible in daylight. But it's the Globolight®, the unique luminous ceramic from which they're hewn, that produces their astounding, super-brilliance at night. And inspired this timepiece's name. The light show doesn't end there. Carved from titanium, the 41mm case incorporates a second sapphire crystal displaying its super-accurate movement. But it's not the back of this beautiful tool watch you're buying into. Is it?

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Fading memory

New treatments are paving the way to a world without Alzheimer's

ALZHEIMER'S is, quite rightly, among the most dreaded conditions of old age. It robs people of memories, puts immense strain on their carers and exerts a huge financial burden on both individuals and society. Tens of millions of people already have a diagnosis and, if projections are correct, that will more than double by 2050.

Until recently, there seemed no hope of averting this catastrophe, but rapid medical progress has raised the realistic prospect that Alzheimer's can be treated – and eventually eradicated (see page 32).

One of the first of a new class of drugs is already making waves, but not always for the right reasons. Last week, the UK's Medicines and Healthcare Products Regulatory Agency approved a medicine called lecanemab. But NICE, a body that

advises whether new treatments are cost-effective, has issued a preliminary decision that this won't be funded by the taxpayer in England. Decisions have yet to be made for the rest of the UK.

This is obviously a bitter pill for people with Alzheimer's and their loved ones to

"The next wave of drugs that go after the causes of Alzheimer's could be ready by around 2030"

swallow. But in the grand scheme of things, it is good news. Lecanemab isn't a particularly effective drug – its benefits are modest, it can have severe side effects and it is expensive – but it shows we now understand the causes of Alzheimer's and can treat them. That is strengthened by the

fact that the drug has also been approved in the US and Japan, though the European Medicines Agency has rejected it.

The path is therefore largely cleared for the next wave of drugs that go after the causes of Alzheimer's, which could be ready by around 2030. These are vaccines – not in the traditional sense of providing immunity against infectious diseases, but they work in fundamentally the same way, prompting an immune response, in this case against the misfolded proteins that cause Alzheimer's symptoms. The first will be therapeutic vaccines to slow or halt the progression of the condition, but the next generation will be prophylactic, designed to prevent it from ever developing. Eventually, the only fading memory will be of Alzheimer's itself. ■

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**Alzheimer's
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Biological power
DNA computer solves
simple chess and
sudoku puzzles **p10**

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Antimatter version
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is the heaviest yet **p19**



Astronomy

**The birthplace of
star-like planets**

This startling image of star-forming nebula NGC 1333 is made from a mosaic of images taken by the James Webb Space Telescope. The nebula is in the Perseus molecular cloud, about 960 light years away from us. The images have revealed six new planet-sized worlds. None of them orbits a star, so they probably formed when clouds of dust and gas collapsed, much as most stars are born.

ESA/WEBB, NASA/CSA, A. SCHOLZ

Will mpox be a global pandemic?

A new variant of mpox is surging in Central Africa, raising concerns about how quickly it could spread, reports **Michael Le Page**

A NEW mpox variant called clade Ib that emerged in the Democratic Republic of the Congo last year has now spread to several neighbouring countries. Sweden and Thailand have also each detected a case in individuals who travelled from this region. So, how serious a threat is it?

It is clear that mpox clade Ib is nowhere near as transmissible as respiratory viruses such as SARS-CoV-2, and thus it almost certainly won't cause a pandemic on the scale of covid-19. However, initial evidence suggests that clade Ib is significantly better at spreading from person to person than other mpox variants, such as clade IIb, which has caused nearly 100,000 reported infections worldwide since 2022.

Mpox, formerly known as monkeypox, normally infects rats and squirrels. There are two main types of mpox, clade I and clade II, with the former circulating in Central Africa and the latter in West Africa. These viruses occasionally spill into people, but the resulting outbreaks have usually been small and limited to households, because the virus isn't good at spreading among people. Most infections involve close contact, including, but not limited to, sexual contact, says Susan Gould at the Liverpool School of Tropical Medicine in the UK.

People can also be infected by touching contaminated objects, such as bedding, but this is rarer. Gould detected the virus in air samples in one study, but this doesn't mean it can spread via the air, she says. "There is no evidence of any cases where there's airborne transmission."

The ongoing outbreak of clade IIb, a type of mpox clade II, is the biggest and by far the most widespread, but it has been limited almost entirely to men who have

R. SATISH BABU/AFP VIA GETTY IMAGES



An mpox awareness banner at an airport in Chennai, India

sex with men. In Europe, 98 per cent of cases have been in men. Genetic studies revealed that IIb had been circulating in people for several years prior to its detection.

Now, Ib cases are surging, with more than 15,000 reported human cases and over 500 deaths. Reports also state that Ib is even more transmissible than IIb, with signs of increased spread outside of households.

Whether it really is more transmissible isn't yet confirmed, says Brian Ferguson at the University of Cambridge. "There isn't any hard evidence." The picture will become clearer as any Ib outbreaks outside of endemic regions are studied.

In 2022, the expectation was that standard measures such as contact tracing would halt the spread of IIb, which turned out not to be the case. One reason for this may be that people infected with IIb can become infectious

several days before showing symptoms or even without showing any symptoms at all. But offering vaccines to those at high risk has greatly reduced the virus's spread in wealthier countries.

"They were highly effective," says Paul Ananth Tambyah at the International Society for Infectious Diseases. "They brought down case numbers to really very low levels."

It remains to be seen whether Ib can be contained by measures such as contact tracing, not least

1-11%

The overall case-fatality rate range of mpox clade I

because we don't know if it can spread before people show symptoms. It is possible that countries with effective healthcare systems will manage to contain outbreaks, but other nations may not. "There is a potential for that to happen," says Ferguson.

If Ib does spread widely in some

countries, there is also a risk of mpox becoming established in animal populations outside of West and Central Africa, which could lead to future outbreaks starting in non-endemic areas.

On the plus side, mpox evolves more slowly than viruses such as SARS-CoV-2. It is therefore thought to be very unlikely that it could evolve to evade existing vaccines. But Ferguson stresses that such conclusions are based on probability. "There's a chance that it can change in a way that we can't predict," he says.

Assuming Ib doesn't change much, vaccination campaigns should be able to bring any wider outbreaks under control. But vaccine availability is an issue and could become even more of a problem if Ib isn't limited to a relatively small high-risk group, as with IIb.

"There aren't currently 10 million shots of vaccine available," says Ferguson. That is the number estimated to be needed to halt the clade Ib outbreak just in Central Africa. Manufacturers are ramping up production but it will take time.

Clade I's overall fatality rate ranges from 1 to 11 per cent, depending on the populations affected and the degree of infection surveillance. In countries with better healthcare systems, it will probably be on the lower side of that range.

Tambyah thinks Ib will behave similarly to IIb, but it is unlikely to spread to the same extent if countries act quickly, given that they have dealt with mpox before and people may have some immunity. But if nothing is done to stop mpox outbreaks in West and Central Africa, more variants will emerge, he says. "And we'll go through this whole cycle all over again." ■

Physics

Quantum trick can cool things despite using nothing at all

Alex Wilkins

IN THE strange world of quantum mechanics, nothing isn't actually nothing – and now we have found that nothing, or the absence of a photon, can even be used to lower the temperature of an object.

One of the most common ways scientists cool things is by using lasers. When particles of light, or photons, with a specific frequency hit an atom or molecule, it absorbs the photon and fires out another photon with higher energy, which cools the system overall.

But strangely, placing a photon detector next to an atom to count the photons given off results in the laser instead raising the system's temperature.

This is because in quantum mechanics, the act of measurement can alter the state of a system. Measuring the position of an electron, for example, changes it from a cloud of possible positions to a specific place.

Similarly, detecting a photon confirms that the system had

enough energy to produce that photon, and measuring this raises its energy, or temperature.

Now, Michael Vanner at Imperial College London and his colleagues have found that setting up a detector to look for the absence of photons has the opposite effect, and can make objects colder if no photon is detected. "It cools the

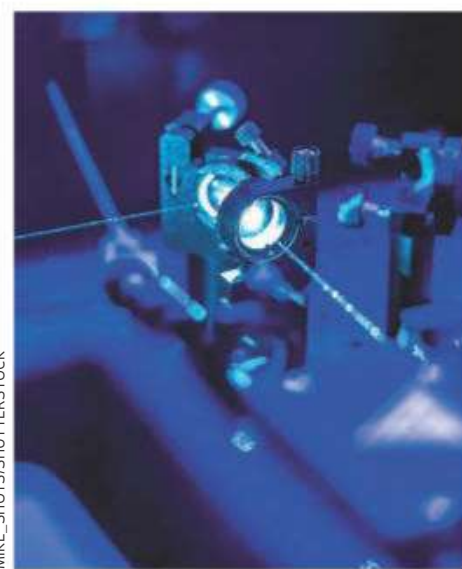
"The cooling effect is small, but it could be useful for storing information in a future quantum internet"

acoustic vibrations even further than laser cooling alone," says Vanner. The researchers fired an infrared laser at a glass bead that was 200 micrometres wide, or twice the width of a human hair. This produced sound waves that travelled through the bead and generated their own radiation, which slowed down and cooled the waves in a conventional laser cooling scenario.

The researchers put a system that looks for the absence of photons next to the bead. This has two detectors: one to only measure single or no photons, and another that records all the photons given off by the bead. By comparing the detectors, Vanner and his team could record the times when zero photons were given off. This meant there were no sound waves energetic enough to produce light, which equates to a cooler overall system (arXiv, doi.org/ndr2).

The cooling effect is small, says Vanner, but it could be useful for storing information in a future quantum internet.

"If you want to synchronise quantum signals of light, or you want to controllably store and release them between operations in a quantum computer, you need a quantum memory," says Vanner. The sound waves can last for milliseconds, long enough to act as a quantum memory, and can be converted to the



MIKE_SHOTS/SHUTTERSTOCK

Lasers can have a cooling effect in quantum experiments

frequency of light used in quantum networks, he says.

"What makes the quantum world interesting is that even the absence of something is still a thing," says Cory Nunn at the National Institute of Standards and Technology in Maryland. ■

Space

Strange metal-rich stars may come from stellar implosions

AFTER a star explodes in a supernova, the remnants can reform into stars again and again. These subsequent generations could be full of elements heavier than helium that astronomers refer to as metals, which could explain why the cosmos is littered with puzzlingly metal-rich stars.

Supernovae are often thought of as explosions, but in the later stages of their evolution, they slam into particles in the surrounding interstellar medium and begin to implode instead. This creates a dense cloud of gas and dust,

enriched with all of the heavier elements that formed in the dying star that produced the supernova.

Leonard Romano at Excellence Cluster ORIGINS in Germany and his colleagues have calculated what happens within those clouds after the implosion. They have found that it can create a cyclical effect, where the cloud gets so dense that stars begin to form, and when those stars eventually explode, the process starts again like a phoenix rising from the ashes. Each cycle would take tens to hundreds of millions of years (*The Astrophysical Journal Letters*, doi.org/ndrz).

Gas from the interstellar medium also plays a role: as it flows into the region of the supernova remnant, it adds mass, allowing more stars to



NASA/CXC/MITIL LOPEZ ET AL./CHANDRA X-RAY OBSERVATORY

form in subsequent generations. "From one phoenix, you get two phoenixes," says Romano. This cycle would probably only happen a few times because of interference

A cloud-like supernova remnant in the Milky Way known as W49B

from nearby stars, he says.

However, even a few cycles could be enough to explain the unusual stars astronomers have spotted with more heavy elements than we would expect from normal star formation processes. Without these cycles, each supernova would pour its metal-enriched dust into interstellar space, where it would be diluted like a drop in the ocean. "The fraction of metals in this cloud is 100 to 1000 times higher," says Romano. "Instead of a drop of water in the ocean, it's like a drop of water in a pond." ■

Leah Crane

Technology

DNA computer solves chess and sudoku puzzles

Alex Wilkins

A COMPUTER made from DNA that can solve basic chess and sudoku puzzles could, if scaled up, save vast amounts of energy compared with traditional computers for training artificial intelligence models.

Albert Keung at North Carolina State University and his colleagues have developed a computing system that uses cellulose microparticles to store many DNA strands at once, which makes it more stable and reusable than previous DNA computers. “We found that this marriage of DNA with a synthetic material gives you a whole host of new practical capabilities,” says Keung.

The DNA holders resemble a branched nerve cell, allowing them to store DNA-encoded data densely, at 10,000 terabytes per cubic centimetre. DNA stored like this at 4°C (39.2°F) should stay intact for 6000 years, says Keung. Unlike other such computers, this set-up means the DNA isn’t destroyed during computation. Instead, an enzyme is used to transcribe the DNA strands into RNA, which can then be read out by a sequencing machine, leaving the original data intact.

To demonstrate the system, the researchers encoded three JPEG pictures in around 2000 DNA strands and read each out 10 times. They also used it to solve simple chess and sudoku problems on a 3-by-3 grid by loading each of the roughly 1000 possible board configurations into the DNA microparticles and then transcribing them into RNA. An enzyme was used to eliminate any solution that would break the rules of chess or sudoku, leaving only valid solutions (*Nature Nanotechnology*, doi.org/nds3).

DNA computers are well suited to solving such problems, says Keung, and could be less expensive and energy-intensive than the processors used to train AI. ■

Physics

Blow for dark matter search as biggest hunt yet finds nothing

Leah Crane

THE latest hunt for dark matter has come up empty handed so far, but the upside is that physicists can now set the tightest constraints ever on the nature of this mysterious substance. New measurements from the LUX-ZEPLIN (LZ) experiment in South Dakota mean we are either closer than ever to finding particles of dark matter or ruling out the most popular explanation for it.

Dark matter doesn’t interact much with regular matter or with light, so we can’t see it. We only know that it exists because of its gravitational effects and those effects indicate it makes up over 80 per cent of all matter.

The leading explanation for dark matter has long been that it is made up of weakly interacting massive particles (WIMPs), but hunts for these fundamental entities have found nothing yet.

LUX-ZEPLIN, a dark matter detector made of 7 tonnes

An array of sensors for the LUX-ZEPLIN dark matter experiment in South Dakota

of liquid xenon buried 1.5 kilometres underground, is the most sensitive yet, but after 280 days of searching, it hasn’t found any WIMPs. “We’re the world’s best at not finding dark matter,” says LZ spokesperson Chamkaur Ghag at University College London.

~75%

of the possibilities for WIMP particles have been ruled out

While this result may seem like a disappointment, it has allowed physicists to place tight constraints on the nature of dark matter, reducing the range of properties it could have. The constraints are nearly five times tighter than the previous best, drastically narrowing down the possibilities for WIMPs. This work was presented at two physics conferences – TeV Particle Astrophysics in Chicago and LIDINE in São Paulo, Brazil – on 26 August.

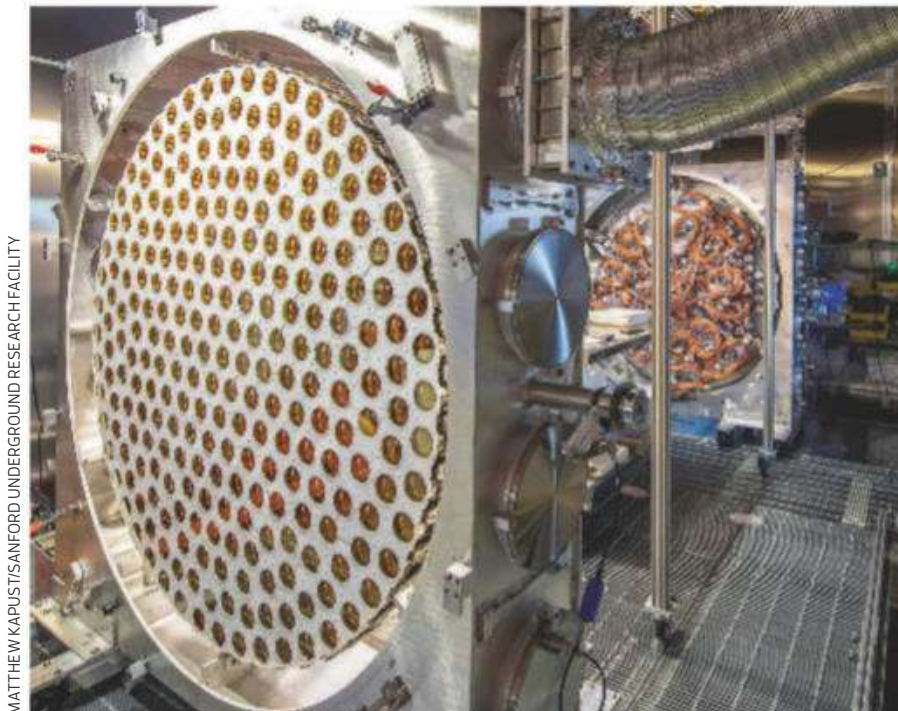
“It’s as if we’ve been told there’s some magical fish that lives in the ocean and we

have no idea where it is,” says Ghag. “We get into the ocean, swim around, get out, get a snorkel, swim around, still don’t find it, get a submarine.” If the magical fish is a WIMP, researchers have now explored about 75 per cent of the ocean without finding it, he says.

“This is the next big step forward, and it’s one in a long line of such steps,” says Dan Hooper at the Fermi National Accelerator Laboratory in Illinois, who wasn’t involved in this work. “In any one of these steps forward, it might be fair to say we don’t expect to see anything. But if you take enough of these steps, it seems not unlikely that we could see something.”

At this point, many initially popular ideas for possible types of WIMPs have been ruled out. There are still some left, but LZ isn’t done yet – it is expected to make 1000 days of observations in total before it ends in 2028. “If LZ doesn’t see WIMPs, and the next generation detector, XLZD, does not see WIMPs, it’s kind of over for WIMPs,” says Ghag. The XLZD project is still in the planning phase.

If WIMPs don’t make up dark matter, that will be a huge paradigm shift, but physicists won’t give up entirely on finding dark matter. “If you’re trying to solve a murder investigation, and you’ve got 20 suspects, and you find out that 10 of them have good [alibis], you don’t go, ‘Well, I guess there wasn’t a murder’. You just have a better idea of who the right suspect might be,” says Hooper. “We cross some of our suspects off the list, and the search gets narrower and more focused – that’s what progress looks like in this field.” ■



MATTHEW KAPUST/SANFORD UNDERGROUND RESEARCH FACILITY

Why do covid cases rise in summer?

Flu and other respiratory viruses seem to barely exist outside of winter, so how come covid-19 is different, asks **Carissa Wong**

TRADITIONALLY, summer is a season of sunburn and allergies, while winter is a time for sniffles and flu, but one pathogen now seems to be upending our yearly cycle of medical maladies: the coronavirus behind covid-19.

This infection rises not just in winter, but in summer too, driving a recent rise in cases in countries such as the UK, US and France – where at least 40 Olympic athletes were infected. In England, there were about 180 reported daily cases on average in early April, rising to more than 500 in mid-July. So, what's going on?

Why does covid-19 have summer surges?

Covid-19 only emerged at the end of 2019, but a pattern has started to become clear: infections rise in both winter and summer. For example, the UK reported close to 7000 new cases a day at the end of 2022, which fell to around 300 in mid-July 2023 and increased to more than 1000 that August.

This is probably partly down to SARS-CoV-2, the virus that causes covid-19, mutating more rapidly than other common respiratory viruses – like flu or respiratory syncytial virus (RSV) – leading to new variants that our immune system may be less equipped to fight off. “It oftentimes takes a couple of years for significant immune-evading mutations to accumulate with flu, and with RSV it happens very rarely, but with covid, it seems to be happening multiple times within a particular year,” says Andy Pekosz at the Johns Hopkins Bloomberg School of Public Health in Maryland.

Despite new variants sometimes compromising our immunity, our ability to fight off viruses is generally not completely depleted if we have been vaccinated or infected



DAVE HUNT/EPA-EFE/SHUTTERSTOCK

with another variant before.

Nevertheless, SARS-CoV-2 is a relatively new infection, so people haven't developed long-term immunity to it, says Marc-Alain Widdowson at the World Health Organization. “With the vast majority of respiratory infections, your immune system is kind of branded with them as a kid through repeated infections over several years,” he says.

This weaker immunity to SARS-CoV-2 paired with its rapidly mutating nature also means cases are at a higher

“We need to keep watching the virus to see if it fits into a pattern that makes it easier to deal with”

baseline level throughout the year than flu or RSV. As a result, “you would expect surges to start and move at a faster level”, says Pekosz.

It isn't clear why certain infections are most prevalent in winter, but it could partly be due to people generally socialising

indoors during the cold months, aiding transmission. Although warmer, summer is also often a sociable time of year, when people may travel, says Francois Balloux at University College London. Such conditions could increase the transmission of any respiratory infection, but having SARS-CoV-2 cases exist at a higher baseline may prompt more infections in summer than happens with other viruses, says Balloux.

Are summer surges here to stay?

The experts are unanimous that covid-19 hasn't existed for long enough to reliably say if surges will settle into a predictable pattern. But Widdowson suspects that, in time, they will probably cluster in winter, because that is the pattern with other coronaviruses that cause common cold-like symptoms.

But Balloux says the rapid emergence of new SARS-CoV-2 variants makes it difficult to gauge when covid-19 will ebb and flow. “I think we'll see,” he says.

Some athletes wore face masks after a spate of covid-19 cases at the Paris Olympics

Like other respiratory viruses, SARS-CoV-2 clearly spreads most in winter, so the largest annual surge will almost definitely continue to occur then, says Pekosz. “I think we just need to really keep monitoring the virus to see if it follows our wishes and fits into a pattern that makes it more easy for us to deal with it.”

Should covid-19's seasonal trend influence vaccinations?

Earlier this year, several nations launched spring covid-19 vaccination campaigns. However, despite around 7 million people being eligible for a vaccine through England's National Health Service, only just over 4 million were administered, for example.

“Summer surges, particularly causing severe disease in vulnerable populations, may mean that we have to do more to mitigate disease in the summer to really help target those populations,” says Pekosz.

With SARS-CoV-2 having a relatively high baseline of cases throughout the year, getting vaccinated in any season would probably have benefits, says Widdowson.

However, the most recent spring vaccines had the same formulations as those developed for previous autumn roll-outs, making them less useful against new variants. Vaccines can take months to develop, so manufacturers may be unable to make several versions every year, says Pekosz. Yet if covid-19's summer surge is here to stay, such efforts may be necessary, he says. ■

For more on covid-19, see page 12

Astronomy

We might finally know what made the mysterious Wow! signal

Alex Wilkins

AN UNEXPLAINED radio blast detected in 1977 known as the Wow! signal, which some have interpreted as an alien message, may have been the result of a natural galactic laser-like beam.

On 15 August 1977, the Big Ear radio telescope at Ohio State University detected a brief, powerful burst of radio waves with an unusually narrow range of frequencies, similar to atomic hydrogen's natural emission frequency. No known astronomical processes could have produced such an emission, and astronomer Jerry Ehman, who worked at the telescope, jotted down the phrase "Wow!" in red pen on a printout of the signal.

The now famous Wow! signal has defied explanation in the decades since its observation. Some people have said that an advanced alien civilisation could have been responsible. Astronomers have also put forward less exotic ideas, such as fast-moving comets releasing clouds of hydrogen gas, but it was unclear how they might produce a strong enough signal.

Now, Abel Méndez at the

Astronomer Jerry Ehman's jottings led to the Wow! signal's name



NAIC/ARECIBO OBSERVATORY/NSF

University of Puerto Rico at Arecibo and his colleagues have spotted similar signals from clouds of hydrogen atoms in front of red dwarf stars in our galaxy. They are less powerful than the original Wow! signal, but Méndez and his team think a powerful light source passing behind the clouds, like a flare from a highly magnetic neutron star – a magnetar – could stimulate the hydrogen atoms to fire out a beam of microwave radiation, known as a maser.

Méndez started looking for Wow!-like signals when he realised that the Arecibo telescope, which collapsed in 2020, and the Big Ear telescope had similar experimental set-ups. He and his team were already searching for signals

The Arecibo telescope in Puerto Rico detected signals like the Wow! one

from nearby red dwarf stars as part of a project looking for habitable exoplanets, so they combed this data and found multiple examples that were very similar in their frequency range to the Wow! signal.

"The signals that we detected from these clouds are less bright because they are not illuminated by a magnetar," says Méndez. "When you do the calculation, they will become much, much brighter [if they were]."

While astronomers have spotted masers in space from hydrogen molecules – pairs of hydrogen atoms bonded together – they have never seen one from an atomic hydrogen cloud, which is what would be required to reproduce the Wow! signal, says Méndez.

Proving that this was what caused the signal would be an astrophysical discovery in itself, he says. Astronomers could survey the original part of the sky to try to find a hydrogen cloud in front of a magnetar, but unless this object was letting off a flare, which is very rare, then it would be hard to spot, he says.

It is an interesting idea, says Michael Garrett at the University of Manchester, UK, but it is unclear whether atomic hydrogen masers can exist or whether they are required as an explanation instead of just the magnetar by itself. "A magnetar is going to produce [short] radio emissions as well. Do you really need this complicated maser stuff happening as well to explain the Wow! signal?" he asks. "I don't think so. It just makes a complicated story even more complicated." ■

Health

Symptoms of long covid can differ depending on age

Carissa Wong

LONG covid seems to cause different symptoms in younger children and in adolescents. Understanding this better could aid diagnoses.

To date, most long covid research has focused on adults. That is partly due to a misconception that children don't get long covid, says Rachel Gross at New York University.

Now, Gross and her colleagues have tracked 751 children aged 6 to 11 and 3109 aged 12 to 17, who had previously had, according to their caregivers, an infection with the SARS-CoV-2 virus, which causes covid-19.

The researchers defined long covid as having at least one symptom that lasted for more than one month, started or became worse during the covid-19 pandemic and was present at the time of the study.

Among the younger children, these symptoms mainly included sleep problems, trouble focusing and abdominal issues, such as pain, nausea, vomiting and constipation.

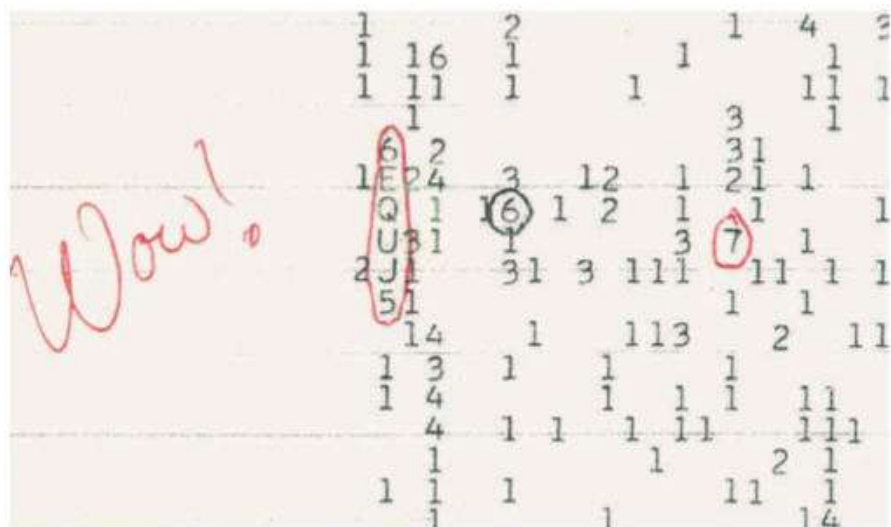
These symptoms were much less common among nearly 150 children of the same age who hadn't previously been infected, verified by them having no antibodies against the virus in their blood samples.

In contrast, teenagers' symptoms generally included pain, fatigue and a loss of smell or taste, compared with 1300 of their uninfected counterparts (*JAMA*, doi.org/ndqx).

Why these differences exist between the age groups is unclear, but it could be down to variations in their hormonal and immune systems, says Gross.

Alternatively, teenagers may simply be better able to vocalise their symptoms than younger children, says Danilo Buonsenso at the Gemelli University Hospital in Rome, Italy.

The researchers have developed a scoring system to help diagnose if a young person has long covid. ■



PUBLIC DOMAIN

The surprising science of the Neolithic

A monument built between 3600 and 3800 BC reveals knowledge of geology and physics

Tom Leslie

PEOPLE in the Neolithic Period seem to have understood sophisticated concepts in science, such as those from physics and geology. They used this knowledge to construct a megalithic monument in southern Spain.

Called the Menga dolmen, it is among the earliest such monuments in Europe, dating to between 3600 and 3800 BC. Its roofed enclosure was created from 32 large stones, some of which are the biggest used in such structures. The heaviest one weighs more than 130 tonnes, more than three times as much as the heaviest stone at Stonehenge in the UK, which was built more than 1000 years later.

“[In the Neolithic Period], it must have been very powerful to experience this building made with these enormous stones,” says Leonardo García Sanjuán at the University of Seville in Spain. “It still stirs you. It still causes an impression even today.”

He and his colleagues have now performed detailed geological and archaeological analyses of the stones to infer what knowledge Menga’s builders would have

needed to construct the monument, which is in the city of Antequera. Paradoxically, they found that the rocks are a type of relatively fragile sandstone. While this means a greater risk of breaking, the team discovered that this was compensated for by shaping the stones so they locked into a very stable overall structure.

“It’s like Tetris,” says García Sanjuán. “If you look at the

The Menga dolmen in Spain contains 32 giant stones that make a roof, walls and pillars

precision involved and how well each stone locks with each other, you have to think that they had an idea of angles, however rudimentary.”

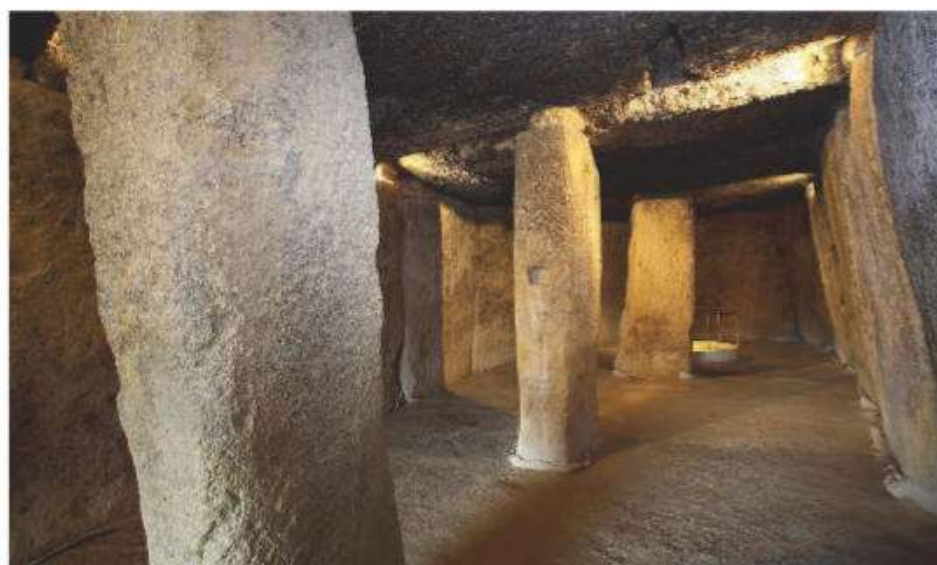
The researchers also found that the 130-tonne stone, which was placed horizontally on top to form part of the roof, had been shaped so that its surface rises in the centre and declines towards the edges (*Science Advances*, doi.org/nd2j). This distributes force in a similar way to an arch, improving the roof’s strength, says García Sanjuán. “To the best

of our knowledge, this is the first time that the principle of the arch has been documented in human history.”

Menga – whose purpose is unknown – is also aligned to produce distinct patterns of light in the interior during the summer solstice and has stones that are protected from water damage by several layers of carefully beaten clay, which adds to evidence the builders had knowledge of architecture and engineering.

“They knew about geology and the properties of the rocks they were using,” says García Sanjuán. “When you put all this together – you know, engineering, physics, geology, geometry, astronomy – it is something we can call science.”

“What’s surprising about this is the level of sophistication,” says Susan Greaney at the University of Exeter, UK. “The architectural understanding of how the weight distribution works, I’ve not seen that anywhere else before.” But she adds that this is perhaps less a demonstration of an understanding of science than of architecture and engineering. ■



MIGUEL ÁNGEL BLANCO DE LA RUBIA

Technology

Blob of jelly can play Pong thanks to a basic memory

AN INANIMATE glob of ion-laced jelly can play the computer game Pong and even improve at it. Such jelly might one day be used to control robots.

Inspired by research that used brain cells in a dish to play Pong, Vincent Strong at the University of Reading, UK, and his colleagues decided to try playing the tennis-like game with an even simpler material. They took a polymer material

containing water and laced it with hydrogen ions to make it responsive to electrical stimuli. When electricity is passed through the material, those ions move to the source of the current, dragging water with them and making the gel swell.

Strong and his colleagues used a standard computer to run a game of Pong and passed current into different points on the hydrogel with a three-by-three grid of electrodes to represent the ball moving. A second grid of electrodes measured the concentration of ions in the hydrogel, which was interpreted by the computer as instructions on where

to move the paddle to hit the ball.

The hydrogel could not only play the game, but, with practice, its accuracy improved by up to 10 per cent and the length of rallies increased. This happens because the hydrogel swells faster than it shrinks, while its rate of swelling slows even as the electrical current remains constant. The researchers say that these properties create a rudimentary sort of memory,

“Instead of it just knowing what’s immediately happened, it has a memory of the ball’s motion”

as signs of the swelling remain recorded in the gel (*Cell Reports Physical Science*, doi.org/ndst).

“Instead of it just knowing what’s immediately happened, it has a memory of the ball’s motion over the entirety of the game,” says Strong. “It sort of becomes a black-box neural network that has a memory of the ball’s behaviour.”

Strong says the hydrogel could work as an analogue computer or have other uses. “I won’t rule out having a hydrogel thing inside the brain of robots,” says Strong. “That sounds cool, and I’d like to see it.” ■ Matthew Sparkes

Most climate policies aren't effective

Only a slim minority of climate policies have led to a significant reduction in carbon emissions, with most being too specifically targeted to make a big difference, finds **Chris Stokel-Walker**

THE vast majority of climate policies fail to significantly reduce emissions and so make little difference to stopping climate change, suggesting that governments must work harder to identify ways to shift the needle.

Nicolas Koch at the Mercator Research Institute on Global Commons and Climate Change in Berlin and his colleagues discovered this by assessing the impact of 1500 climate policies put into force between 1998 and 2022, covering 41 countries across six continents.

They began by using machine learning to identify moments when a country's emissions dropped significantly, relative to a control group of other nations not included in the analysis. The researchers found 69 of these emissions "breaks" and compared them with an Organisation for Economic Co-operation and Development (OECD) database that tracks what types of climate policies were enacted when.

While matching policy shifts to emission changes isn't an exact science, the team was able to attribute 63 of these breaks to one or more policy interventions within a two-year interval around the break, in order to allow for lagged or anticipated effects.

Each of the 63 breaks saw a reduction in emissions by between 0.6 billion and 1.8 billion tonnes of carbon dioxide, but overall the researchers found that most climate policies don't achieve anywhere near this level of success. "We have a lot of policies out there that have not led to large emission reductions, and more policies do not necessarily equate to better outcomes," says Koch.

Many policies fail because they are too specifically targeted, he says. For example, governments may subsidise the purchase of

WIKTOR SZYMANOWICZ/FUTURE PUBLISHING VIA GETTY IMAGES



The Restore Nature Now rally in June called for the UK government to take action

new electric cars, but most cars on the road aren't electric, so the impact is minimal. One tool that seems effective is outright bans – for example, stopping coal being used to generate electricity – but as these were always used in conjunction with other measures, it was difficult for the team to identify if they worked in isolation (*Science*, doi.org/ndr6).

Politicians looking for a one-size-fits-all blend of policies are out of luck, because none worked across all sectors. Pricing seems to be the most effective measure, says Koch, particularly in reducing the emissions of industries, but it isn't the sole solution. "What we observe is that the most frequently used policy tools, which are subsidies and regulations, alone are insufficient," he says. "Only in combination with price-based instruments – such as carbon prices, energy taxes – can they deliver substantial emission reductions." In other words, people only cut back on emitting when continuing would hit their wallet.

"The key value in the paper is in identifying those clean breaks in emissions in specific sectors and

countries," says Matthew Paterson at the University of Manchester, UK. He points out that the OECD database used has limitations because the government documents from which it pulls its content aren't consistently reported across the world, but says it is the best available for the purposes of this study.

"As they say, it has been known for a while that climate policies can work best in combination, but they give us more specificity about which combinations work in which circumstances," says Paterson. That can then be used to more aggressively mix policies to best tackle emissions.

Marion Dumas at the London School of Economics and Political Science, UK, says the work should be useful for policy-makers, but the team's method may not fully capture the reality of policy interventions, as it looks at the emission trends – or outcomes – first, then works backwards to find the cause. The two-year interval around each break may also be too narrow, she says, discounting the impact of more gradual, longer-term policy changes.

"It's important not to overinterpret the headline result that only a few policies can be tied to emissions reductions," says Robin Lamboll at Imperial College London, because smaller emissions cuts not picked up by the team's method may combine to make big differences.

A larger issue is that any policy must be palatable to the public. "In any specific country or sector, it will be political dynamics that drive whether such a mix can be implemented," says Paterson.

The findings can be taken as good news, says Koch. "In general, it's possible to have these policies to achieve these very ambitious goals." ■

1500

climate policies were assessed for their effectiveness

63

instances of emissions drops were associated with climate policies

0.6-1.8

billion tonnes of carbon dioxide were cut in each of these drops

Biotechnology

Bacteria destroy antibiotic resistance genes in wastewater

Grace Wade

MORE than 99 per cent of genes in wastewater that confer antibiotic resistance can be removed by bacteria engineered to destroy DNA. Treating wastewater with this method could help slow the spread of antibiotic resistance.

Disease-causing bacteria can absorb resistance genes that damaged or dead bacteria have released into the environment. This makes wastewater one of the largest environmental reservoirs for antibiotic resistance genes, says James Tiedje at Michigan State University. Affected microbes can spread to people through water, food or livestock.

Tiedje and his colleagues have developed a way to remove this threat by genetically engineering the common bacterium *Shewanella oneidensis* to churn out enzymes that break bonds in free-floating DNA strands. "It just basically chops it up into pieces, so it is no longer able to be transferred to other organisms," says Tiedje.

They tested the microbe in wastewater samples from different stages of treatment. After 4 hours, the engineered microbes destroyed more than 99.9 per cent of genetic material in all the samples, and after 6 hours, all of the antibiotic resistance genes were destroyed (*Nature Water*, doi.org/ndrx).

Current strategies for removing genetic material from wastewater are costly and can come with environmental trade-offs, says Anthony McDonnell at the Center for Global Development in London. For instance, chemical disinfectants can produce harmful by-products. Genetically modified microbes are a promising alternative, he says.

The microbes produce no by-products and can be cheaply grown even without high-tech equipment, says Tiedje. It would cost about £0.08 to treat a litre of water with this strategy, he says. ■

Space

SpaceX tweaks Starlink to save radio astronomy from satellites

Jeremy Hsu

RADIO telescopes observing the cosmos face growing challenges because of electromagnetic interference from thousands of satellites in low Earth orbit. Now, experiments involving SpaceX's Starlink satellites have shown how to virtually eliminate part of this problem.

As satellites like this hurtle around the planet, they send so-called downlink signals to Earth to provide internet and communication services. When they pass through areas of the sky where radio telescopes are observing, the temporary blips from those signals can potentially impact hours of data collected by instruments that cost millions or even billions of dollars to build and run.

In 2023 and 2024, SpaceX worked with the US National Science Foundation's National Radio Astronomy Observatory (NRAO) to test a potential solution: Starlink satellites could temporarily redirect

or switch off their downlink transmissions while moving through the line of sight of an active radio telescope.

This represents "one of many possible solutions for a pressing problem", says Bang Nhan at the NRAO. "The number of satellites is going to increase exponentially in the coming years, which would mean radio astronomers will see more interference more often."

"The number of satellites is going to increase exponentially in the coming years"

Avoiding this is particularly important when radio telescopes are doing what are known as calibration scans, lasting a few minutes. Interference then could negatively affect hours-long observation runs, says Nhan. He also says extreme interference could potentially damage some radio telescopes' electronic components.

Nhan and his NRAO colleagues coordinated tests with SpaceX that involved the

Green Bank Observatory in West Virginia pointing its radio telescope, one of the largest in the world, towards parts of the sky crisscrossed by dozens of Starlink satellites. SpaceX set these satellites to redirect their downlink signals to avoid the observatory site. Satellites passing near the telescope's line of sight temporarily disabled these signals entirely, reducing interference (*The Astrophysical Journal Letters*, doi.org/ndsb).

The beam avoidance demonstrations seem to have achieved a "noticeable impact", says Federico Di Vruno at the International Astronomical Union's Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference. "If the method is implemented in all telescopes, this would be a huge step forward," he says.

Follow-up tests of the beam avoidance measure have shown similar success at the Very Large Array (VLA) radio telescope in New Mexico, says Nhan. SpaceX voluntarily activated the protective measure for the VLA starting in August and is planning to do the same for the Green Bank Observatory.

But this measure only helps radio astronomers avoid one type of potential interference. Other problems arise when downlink transmissions leak into frequency bands that are protected for radio astronomy or satellite signals fill up parts of the radio spectrum that are passively observed by these telescopes, says Di Vruno.

The work is still helpful, however, and Di Vruno and Nhan hope that such measures can also be implemented by other satellite companies too. ■



MARIANA SUAREZ/AFP VIA GETTY IMAGES

Quantum effect seen at large scale

A weird quantum phenomenon called delocalisation has been measured for a glass bead, helping reveal where the boundary lies between quantum and classical physics, finds **Alex Wilkins**

THE fuzziness of the quantum world has been demonstrated at its largest-ever scale, probing the limits of quantum mechanics. More than a billion atoms inside a glass bead have acted as a single quantum wave, a crucial step in making macroscopic matter interfere with itself and testing possible theories of quantum gravity.

In the early 20th century, physicists realised that, at tiny scales, matter appeared to be fuzzy. Although previous experiments had shown that particles like electrons or atomic nuclei were solid, experiments demonstrated that they could also act as waves, interfering with each other like ripples on a pond.

This wave-like nature meant that particles' positions couldn't be precisely pinned down, but could only be described as a cloud of probabilities until this cloud was disturbed by an outside interaction, like a measurement.

Destructive interactions

This fuzzy phenomenon, known as delocalisation, is a fundamental principle of quantum mechanics and appears to be universal for minuscule things. Most physicists assume that delocalisation also exists at much larger scales, but we don't see it because the fragile,

"If we switch off the laser, what happens is similar to when you throw a rock in the lake"

wave-like cloud of probabilities is destroyed by myriad interactions with other particles.

However, it is unclear how far the fuzziness of the quantum world extends for large objects and whether it can be observed if these interactions are removed.

Now, Massimiliano Rossi at ETH Zürich in Switzerland and his colleagues have measured the quantum wave nature of a 100-nanometre glass bead, one-tenth the width of a human hair, containing billions of atoms.

To measure the bead's fuzzy quality, Rossi and his team first had to localise its position with extreme precision. This was to ensure that the measured delocalisation wasn't just from the non-quantum uncertainty of not knowing where the particle exists or from random jiggling caused by heat.

To do this, they trapped the bead using an infrared laser, which could precisely measure the particle's position and record

Quantum effects result in particles behaving like waves that interfere with each other

its random jiggling. They also placed the bead and laser inside an extreme vacuum, so that once the particle was delocalised, its delicate quantum nature wouldn't be disturbed by passing molecules.

100 nm

The diameter of a glass bead that acted as a quantum wave

Once the bead's position had been measured, the researchers momentarily turned the laser off, which made the bead's wave nature take over.

"If we switch off the laser, what happens is similar to when you throw a rock in the lake," says Rossi. "At first, the surface is perturbed only at the rock location, it's only the water around that rock that starts to move. But if you then wait some time, this wave starts to expand and

propagate." The researchers then switched the laser back on and recorded the bead's position.

By repeating this experiment hundreds of times, they gained a picture of the bead's fuzzy character over a scale of picometres, about 100,000 times smaller than the bead itself (arXiv, doi.org/ndqb).

The next step will be to record the bead's wave-like nature over distances of about the same length as the bead itself, which will make it possible to do interference studies, similar to the famous double-slit experiments, but with macroscopic matter, says Rossi.

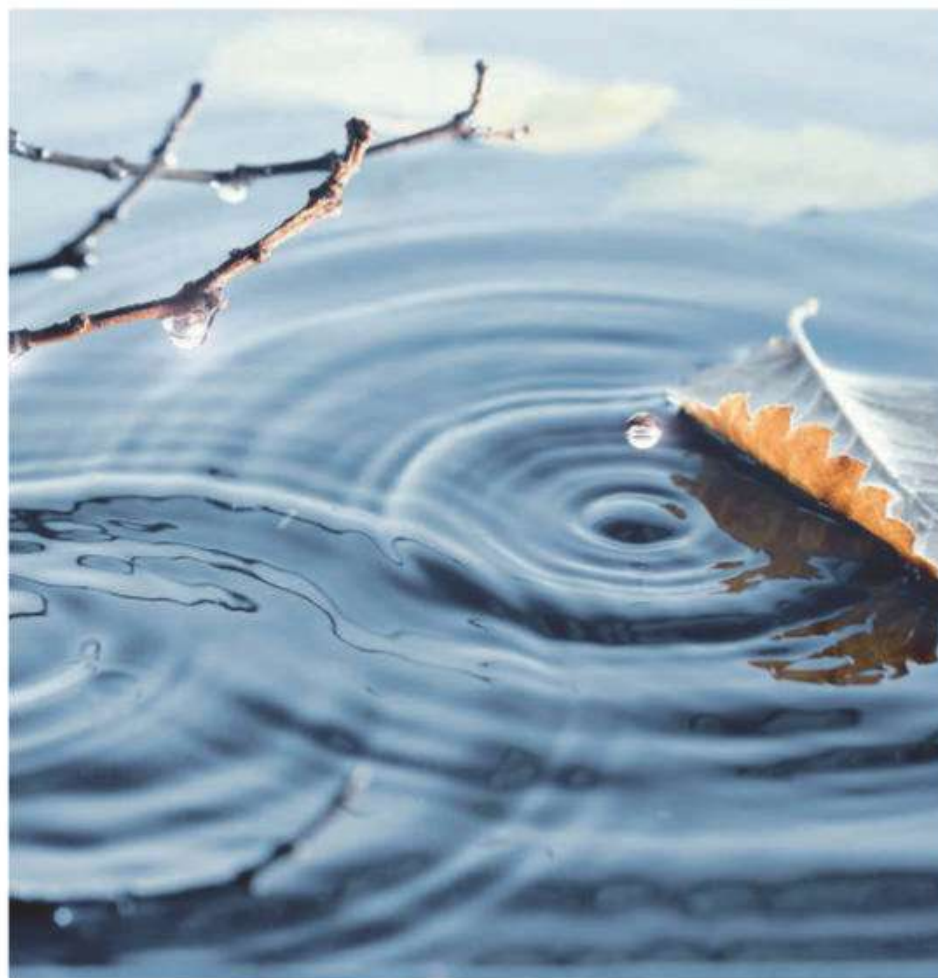
Uniting theories

Experiments like these will also allow us to test possible theories of quantum gravity. Physicists still don't know whether gravity at its most fundamental level is made up of discrete levels and energies, like light is, or whether it is smooth and indivisible on the same length scales as quantum phenomena.

It is hard to test gravity's nature at tiny lengths because it is comparatively much weaker than other forces, but it would have an effect on the evolution of the wave that Rossi and his team measured, says Hendrik Ulbricht at the University of Southampton, UK.

In particular, the evolution of the bead's wave would look different according to whether gravity was quantised or continuous, says Ulbricht.

"If you are able to generate [interference with] another particle like the one which they have, then you could study how it then evolves and if gravity plays a role in its evolution," says Ulbricht. "Then you can answer these kinds of questions of quantum gravity. It's exciting stuff." ■



SHUTTERSTOCK/TILIALUCIDA

Health

Evidence mounts that eating lots of meat can raise your risk of type 2 diabetes

Carissa Wong

EATING meat has once again been connected to an increased risk of type 2 diabetes, but experts disagree on whether there is a clear causal link.

Red and processed meat in particular have previously been linked to type 2 diabetes, in which blood sugar levels get too high, but some argue the evidence is weak.

To get a better understanding, Nita Gandhi Forouhi at the University of Cambridge and her colleagues have analysed the meat consumption of 1.97 million adults, mainly aged 40 to 60, who took part in research projects around the world. They then linked this to diagnoses of type 2 diabetes over the next decade.

The results suggest that for every 50 grams of processed meat eaten per day, the risk of type 2 diabetes goes up 15 per cent, on average, while an extra 100 g of unprocessed red meat per day was linked to a 10 per cent higher risk (*The Lancet Diabetes and Endocrinology*, doi.org/ndr7).

“There’s a lot of plausible biology here,” says Dariush Mozaffarian at Tufts University

in Massachusetts, who particularly points the finger at haem iron in red meat. This mineral can raise levels of inflammatory molecules that may damage cells in the pancreas that produce insulin, the hormone that helps control blood sugar. Eating high amounts of salt, often found in processed cured meats like salami, has also been linked to type 2 diabetes.

While the new analysis is large, the studies it consists of aren’t

Red meat may be best enjoyed in moderation

randomised controlled trials, the best quality evidence, so it can’t prove cause and effect. The studies are also based on people self-reporting what they ate, which is prone to error, says John Ioannidis at Stanford University in California.

“At this point, there’s an association,” says Duane Mellor at Aston University in Birmingham, UK. “The size of the effect is not big enough to suggest causality.”

Despite this, the analysis is convincing some people. “I would say the evidence is strong,” says Xiao Gu at Harvard University.

Forouhi and her colleagues also linked poultry to an increased risk of type 2 diabetes. Like with red meat, the results suggest that for every 100 g of poultry eaten per day, the risk rises by 10 per cent.

Gu says the link to poultry is less convincing because it wasn’t consistent across the various groups in the analysis.

The time it takes conditions like type 2 diabetes to develop means randomised controlled trials would need decades of follow-up before a causal link between meat consumption and type 2 diabetes could be proved.

England’s National Health Service already recommends that people limit their consumption of red and processed meat to no more than 70 grams per day. The latest study confirms that dietary guidelines are already on the right track, says Mellor. Red meat can be a key source of nutrients, such as vitamin B12 and iron, he says.

“Meat is not necessary for a healthful diet, but for those who enjoy intake, the science supports modest intake of unprocessed red meat,” says Mozaffarian. ■



GLYN THOMAS PHOTOGRAPHY/LAMY

Archaeology

Cocaine was used in Europe earlier than we thought

THE mummified brain tissue of two people found in a 17th-century crypt in Milan, Italy, contains traces of cocaine, revealing that the drug was being used in Europe 200 years earlier than previously recorded.

Coca leaves, from which cocaine is derived, have been chewed in the plant’s native South America for thousands of years, but the drug only took off in Europe in the 19th century.

Spanish explorers learned of the psychoactive properties of coca leaves, but kept the knowledge within the Spanish Empire, which included Milan. In the 16th century, they attempted to bring the plant back, but it didn’t transport well – or so we thought.

Now, Gaia Giordano at the University of Milan and her colleagues have looked at nine people who died in the 1600s and were buried in a crypt at the former Ca’ Granda hospital, which treated the city’s poor. The team took samples of brain tissue from each individual to learn what kind of

drugs were being used at the time.

Because cocaine usually vanishes from the body after a few months, Giordano was amazed to find traces of the substance in two mummified brains after almost four centuries. Alongside the active cocaine compound, the team found hygrine, a chemical released by chewed coca leaves (*Journal of Archaeological Science*, doi.org/ndpw). The hospital’s records don’t

“The two individuals had either self-medicated or were chewing coca leaves recreationally”

mention cocaine being prescribed until the 19th century, suggesting that the two individuals had either self-medicated or were chewing the plant recreationally, says Giordano.

This demonstrates that the plant could survive the journey from South America, and that the people of Milan had access to it and knew of its properties.

If poorer people were using coca, “the plant was available on the open market, which is something that probably took a few years”, says Mario Zimmermann at Boise State University in Idaho. ■ Sophie Berdugo

The Atlantic's record cooling

After more than a year of record-high global sea temperatures, part of the Atlantic is cooling fast. Why it is happening isn't certain, but it could affect weather around the world, says **James Dinneen**

OVER the past three months, the shift from hot to cool temperatures in the equatorial Atlantic Ocean has happened at record speed. This emerging "Atlantic Niña" pattern comes just ahead of an expected transition to a cooler La Niña in the Pacific Ocean, and these back-to-back events could have ripple effects on weather worldwide.

The swing towards cooler temperatures in both oceans is a welcome change after more than a year of record heat, largely driven by the rise in greenhouse gas emissions and a warm El Niño pattern in the tropical Pacific Ocean that developed in mid-2023.

"We are starting to see that the global mean ocean temperatures are going down a bit," says Pedro

"It's the latest episode in a string of events for a climate system that's gone off the rails"

DiNezio at the University of Colorado Boulder. According to the US National Oceanic and Atmospheric Administration (NOAA), global sea surface temperatures in July were slightly cooler than in July 2023 – ending a 15-month streak of record-high average ocean temperatures.

The Pacific El Niño faded in May, and between September and November, cooler-than-average La Niña conditions are likely to develop there, according to the latest NOAA forecast. This is driven in part by strengthening winds along the equator that allow colder water to emerge from the deeper ocean.

El Niño, on the other hand, is associated with weaker trade winds that reduce the upwelling of cooler water. This multi-year cycle is called the El Niño-Southern Oscillation (ENSO), and it is one of the main sources of natural

PEDRO PORTAL/MIAMI HERALD VIA AP/LAMY



A quickly cooling Atlantic Ocean could reduce storm threats in Miami

likely to influence weather patterns around the world due to their effects on temperature and humidity. A Pacific La Niña is generally associated with dry weather in the western US and wet weather in East Africa, while an Atlantic Niña tends to reduce precipitation in Africa's Sahel region and boost it in parts of Brazil. The two ocean events could also have opposing influences on the ongoing Atlantic hurricane season: the Pacific La Niña is expected to increase the likelihood of Atlantic hurricanes when it arrives in September, but the Atlantic version may weaken atmospheric wave activity that is required for hurricanes to form.

The cycles could also influence each other, but exactly how is hard to predict. There is reason to think the Atlantic Niña could delay the development of La Niña in the Pacific, slowing its cooling effects across the global climate, says McPhaden. "There could be a tug of war between the Pacific trying to cool itself and the Atlantic trying to warm it." ■

variability in the global climate.

Although it has a smaller influence on the climate, the equatorial Atlantic Ocean also fluctuates between warm "Niños" and cold "Niñas" (see graph, below). Like ENSO, this oscillation is also often associated with the strength of trade winds.

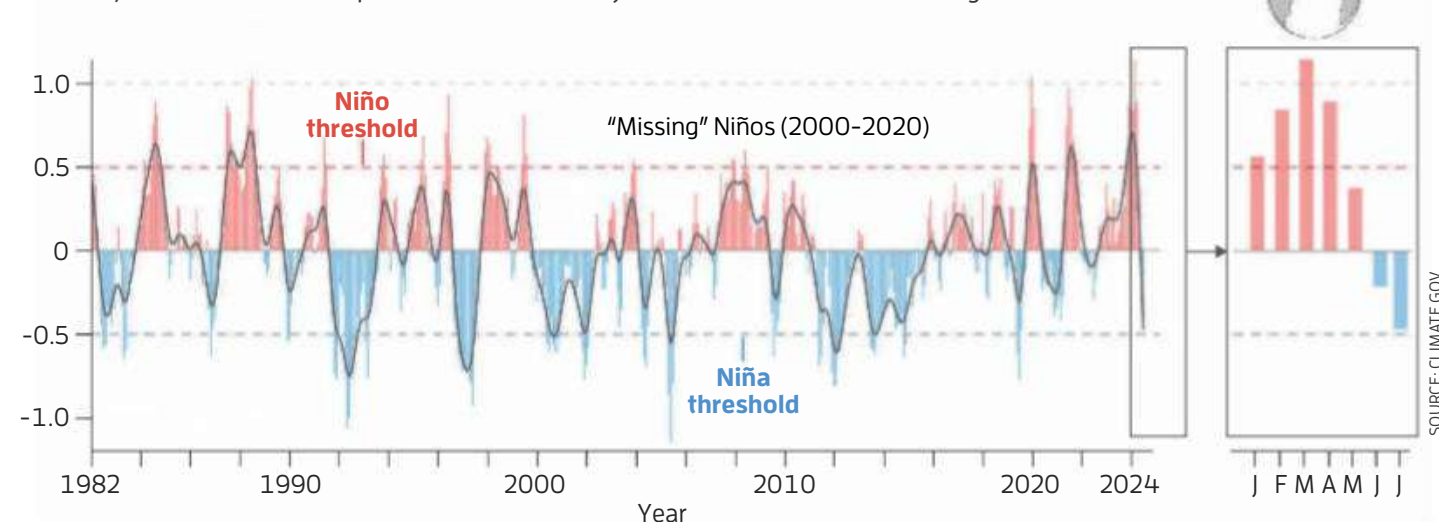
As in the Pacific, the equatorial Atlantic saw unusually hot Niño conditions for much of 2023, and sea surface temperatures earlier this year were the warmest in decades. "It's the latest episode in a string of events for a climate system that's gone off the rails," says Michael McPhaden at NOAA.

Over the past three months, temperatures in that part of the Atlantic cooled more rapidly than at any time in records going back to 1982. This fast shift is perplexing because the strong trade winds that normally drive cooling haven't developed, says Franz Philip Tuchen at the University of Miami in Florida. "We've gone through the list of possible mechanisms, and nothing checks the box so far." If temperatures remain 0.5°C cooler than average for at least another month, it will officially be considered an "Atlantic Niña", says Tuchen.

The two potential Niñas are

Atlantic Niños and Niñas since 1982

Changes in sea surface temperature (°C) from average (with long-term warming trends removed) in the east-central equatorial Atlantic identify when a Niño or Niña has emerged



Particle physics

Antimatter version of an atomic nucleus is the heaviest yet

Karmela Padavic-Callaghan

OUR collection of antimatter just got heavier, because researchers have logged the heaviest antimatter version of an atomic nucleus yet, called antihyperhydrogen-4.

"We didn't think that it was 100 per cent certain we would find it, we just knew we had a chance," says Hao Qiu at the Institute of Modern Physics in China. He and the rest of an international team called the STAR Collaboration briefly formed the new antimatter in an experiment at Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC) in New York.

RHIC can accelerate heavy nuclei of atoms like gold to 99.996 per cent of the speed of light, then smash them together to create a hot particle soup containing unusual combinations of matter and antimatter. Among about 6 billion collisions in the experiment, antihyperhydrogen-4 formed 16 times. It only stayed stable for about 100 trillionths of a second.

This form of antimatter consists of an antiproton and two antineutrons – antimatter versions of the protons and neutrons in a standard atom's nucleus – plus one exotic particle called an antihyperon. It is the antimatter counterpart of the hyperon, a particle that contains at least one rare and heavy "strange quark". Thanks to these components, the new particle is considered a very exotic antimatter "hypernucleus" – and is the heaviest one made so far (*Nature*, DOI: 10.1038/s41586-024-07823-0).

The experiment is part of an effort to understand the differences between matter and antimatter, says Qiu. Our best theories of the universe suggest that, in its earliest stages, it was filled with equal amounts of matter and antimatter, which should have annihilated into nothingness. Studying antimatter particles may help us understand why this didn't happen, says Qiu. ■

Technology

AI could help us keep outdated computer programs working

Matthew Sparkes

MAINFRAME computers running code dating back to the 1960s are still vital to some banks, airlines and government departments, but the skilled engineers familiar with the COBOL computer language these systems use are mostly dead or retired. Now, researchers say artificial intelligence may be able to fill this skills gap and help maintain or replace these antiquated yet essential systems.

COBOL dates back to 1959 and was designed for large, centralised mainframe computers, which carry out bulk data processing for large organisations. When these machines fell out of favour in recent decades and were replaced with many smaller servers, or even cloud services, the language was no longer taught at most universities and we began to lose expertise.

But many of those computer programs remain in use today, often composed of millions of lines of so-called undocumented code, which means it lacks any

COBOL code was used for the IBM system 360 mainframe computer in the 1960s

explanatory notes. When the programs need updating, fixing or replacing, it can be hard to find competent engineers, says Nghi Bui at FPT Software AI Center in Hanoi, Vietnam. "This is a very serious problem," he says.

Bui and his colleagues have been training an AI model called XMainframe on COBOL in the hope that it will be able to interpret code and rewrite it in other programming languages

1959

Year the COBOL computer language was designed

if necessary. In tests, they compared XMainframe's performance at accurately summarising the purpose of COBOL code against several other AI models, including GPT 3.5 and GPT 4, two versions of the large language model behind ChatGPT.

XMainframe's score was six times higher than that of GPT 3.5, which was the most capable of the other models tested (arXiv, doi.org/ndpp).

Other companies such as

Bloop and IBM are also working on AI models to write COBOL. AI won't be able to replace the world's COBOL code on its own, says Bui, but it can accelerate the work of the human coders we do have, helping them quickly understand massive and undocumented systems so that they can migrate them to newer technology. But the process may still take many years, he says.

The US-based recruitment firm COBOL Cowboys, founded by Bill Hinshaw, places hundreds of programmers into short-term contracts annually, with clients ranging from banks to insurers and even sensitive government departments.

Hinshaw is sceptical that AI can reliably and autonomously do what his experienced human coders can, or that companies would feel comfortable running AI-generated code on vast mainframes where the stakes are high. "AI will support people; people will never go away," he says.

He also has no concerns about the current supply of human programmers for roles, although the youngest coders on his books are in their 40s and the oldest already well past pension age. Hinshaw is 82 and personally wrote some of the earliest COBOL code to control cash machines, which still runs today.

"I've been hearing about a shortage for over 25 years, of people not being available, getting old, passing away," he says. "Most of [the contractors] are in their 60s, early 70s. They don't want to quit, they want to keep working. So we don't see a problem with COBOL now. Ten years from now, we may see a problem, but right now we don't see a problem." ■



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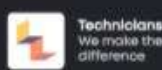
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Comment

Turtle power

A video of a turtle with a straw up its nose changed attitudes to plastic pollution around the world. But we must do more, says **Vanessa Bézy**

NINE years ago, in August 2015, Christine Figgner posted a video of her team removing a plastic straw from the nostril of a turtle. It went viral.

Christine is a friend of mine and fellow marine biologist. We have both conducted sea turtle research off the coast of Costa Rica, where her video was captured. It is emotional and disturbing – but for us this sort of occurrence is common. We regularly find turtles entangled in fishing gear, and I have seen turtles' insides filled with plastic. What surprised all of us was how impactful the video would prove to be.

In the years since, the video's visceral imagery has helped the turtle become the face of the plastic pollution crisis – as exemplified in the comedy *Kim's Convenience*, when a customer reprimands a shopkeeper for using plastic bags because they harm the animals. A huge win for conservation, this association of lovable turtles with single-use plastic has empowered consumers to demand companies do better – the UK banned disposable plastic straws in 2020 and many countries have banned plastic bags.

However, half of sea turtles have ingested some form of plastic, and more than a thousand a year still die from it. They eat this stuff not just because it looks like food, but because it smells like it too. A 2020 study found odours from marine plastic elicit foraging behaviour in sea turtles because plastic becomes “biofouled” by algae



and bacteria that grow on it in the water, making it smell organic.

In order to turn the tide on this devastating loss of marine life, it is vital that we put pressure on big corporations and push for more legislation, especially when it comes to greenwashing. For example, most so-called biodegradable plastics are marketed as eco-friendly, but simply contain additives that break the plastic down more quickly into microplastics. Instead of clogging a turtle's nose, these find their way into the animal's tissues, damaging its physiology.

It is clear that stopping plastic

at its source and removing it from our oceans must be prioritised. We cannot let the nightmare scenario of having more plastic than fish in the sea by 2050 become a reality. While a reduction in overall production of this material will be critical, we also need a raft of initiatives to collect and recycle plastic waste, such as Prevented Ocean Plastic, for which I am an ambassador. This programme works with recyclers in at-risk coastal communities to incentivise the collection of plastic bottles for recycling – just one part of a sector in which technology is improving all the time.

Alongside safeguarding biodiversity, cutting plastic pollution is essential to addressing the climate crisis. Plastic is made from fossil fuels, and emits greenhouse gases for the duration of its existence. In total, its production, conversion and wastemanagement generates about 4 per cent of global emissions – more than the entire continent of Africa.

The rising temperatures caused by these emissions have grave consequences for marine life. Take sea turtles as a case in point. Their sex is determined by the weather. Cooler temperatures produce male hatchlings and warmer ones produce females. An overheating world will result in imbalanced populations, threatening the species' very existence. There are also limits to the temperatures that living organisms can tolerate. Few sea turtle hatchlings survive above 32°C (90°F) and hardly any above 35°C (95°F).

As Figgner's video so clearly demonstrated, it is becoming increasingly difficult to find oceans and marine life devoid of plastic pollution. But rather than discourage us, these powerful images must serve as grim reminders and motivation to drive action on phasing out single-use plastics altogether. ■



Vanessa Bézy is a marine biologist and Prevented Ocean Plastic ambassador

No planet B

Bad habit I am one of millions of vapers in the UK, but growing evidence of the impact these e-cigarettes have on the environment means it may be time to quit, says **Graham Lawton**



Graham Lawton is a staff writer at New Scientist and author of *Mustn't Grumble: The surprising science of everyday ailments*. You can follow him @grahamlawton

Graham's week

What I'm reading

I'm getting into cryptic crosswords, but I'm still learning, so the book on my bedside is The Times Quick Cryptic Crossword Book 9.

What I'm watching

Season two of Irvine Welsh's Crime.

What I'm working on

Quitting vaping, obviously...

This column appears monthly. Up next week: Annalee Newitz

AS I write this, I am vaping. I took up the habit a couple of years ago to help me give up smoking, which I had foolishly fallen back into while coping with the stress of caring for my terminally ill wife. The vape was supposed to be a temporary crutch while I weaned myself off nicotine altogether, but I am still at it.

In that respect, I am not unusual. Most people who use vapes to quit smoking continue vaping for longer than they intended, largely because it is addictive, accessible and relatively safe compared with cigarettes. When I am working from home, I can hardly put mine down. I am now one of 5.6 million adults vaping in the UK – a lot of us are ex-smokers. I think it may be time to cut it out completely. There are increasingly compelling reasons to do so, and not just on health grounds. Vaping is also a growing menace to the planet.

The main problem is disposable vapes, which make up around a third of the tens of millions of vapes and refills bought every year (I have bought the odd one, but mostly use a refillable device). In the UK, disposable vape sales quadrupled between 2022 and 2023, and 5 million of them are thrown away every week.

These devices consist of a plastic tank for a nicotine-containing liquid, a mouthpiece, a battery and a heating element. They last for a relatively short period of time and are then waste. Their discarded corpses can be spotted littering the pavement outside pubs (or the sidewalk outside bars) where they have been casually tossed aside.

That, fortunately, isn't the fate of most exhausted disposable vapes. A recent survey in the US found that about half of younger users get rid of theirs in the trash. About 20 per cent keep their old vapes, probably unsure what to

do with them. Only a handful do the right thing and recycle them.

In any event, the regular trash isn't the correct place for an empty disposable vape. It is just a holding pen for more permanent removal to landfill, and the world already has more than enough plastic and electronic waste rotting away there. Plus they are increasingly designed to be recyclable, and though the availability of appropriate bins is behind the curve, these are springing up more and more.

Dumping a used vape has another major environmental downside. Their batteries contain

“The disposable vapes sold in the UK every year contain enough lithium for 1200 electric vehicle batteries”

valuable metals, such as lithium, which is increasingly in demand – and short supply – for the energy transition. In 2022, an investigation found that the disposable vapes sold in the UK every year contain enough lithium for 1200 electric vehicle batteries.

And it isn't just the afterlife of vapes that we need to worry about. According to a recent review by Marta Lomazzi at the University of Geneva in Switzerland and her colleagues, producing and distributing them consumes energy and water, though how much has yet to be quantified. Rising demand for vapes may increase the amount of land needed to grow tobacco, the source of nicotine for e-liquids. The extraction and purification of nicotine from tobacco also requires a lot of water and produces non-recyclable toxic waste. “The environmental

impact of e-cigarettes presents a novel public health concern that needs to be urgently investigated,” the team concluded.

There is a small upside, possibly: we have good evidence that the availability of vapes has reduced rates of smoking. That could at least make a small dent in the trillions of plastic cigarette butts dropped onto the ground each year, which leach toxic chemicals and degrade into microplastics.

Nonetheless, the knee-jerk reaction is to ban disposable vapes. Belgium and France are in the process of doing just that, prohibiting “puffs” on environmental as well as health grounds. But the evidence that this will achieve much is thin. In the 34 countries that have heeded the World Health Organization's exhortations to ban or stringently restrict vaping to prevent young people from taking it up, rates of vaping aren't much lower than elsewhere. The black market just moves in to fill the void.

Enabling more recycling is a better option, and there is much room for improvement on that front. According to Laura Young at Abertay University in Dundee, UK, vapes rarely come with clear recycling instructions and the infrastructure needed to dispose of them responsibly is still lacking.

But – assuming disposable vapes are here to stay – the most effective solution may be one borrowed from efforts to clean up cigarette butt pollution: make the producers pay. The European Union's directive on single-use plastics will soon force this “mandatory product stewardship” on makers of filtered cigarettes and loose filters. Why not apply this to vapes? The cost would probably be passed on to us poor saps who are hooked on them – but we all need another nudge to quit. ■

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New Scientist video

See inside the Natural History Museum's rare bird archive at youtube.com/newscientist



Nest level



Natural History Museum

THESE elaborate constructions are just some of the birds' nests found at the Natural History Museum in Tring, UK, one of the oldest and largest ornithological collections in the world, with over 1 million specimens.

Some of those pictured are built primarily using dry grass, like that of the spectacled longbill (far left), the only known research specimen, and the opened-up "ball" nest of the desert cisticola (near left, top), which boasts a roof and an entrance hole bound by spider's webs. Others, like the brown noddy's (top middle), are made of a mix of materials, including bird excrement and a colony of calcifying aquatic invertebrates called bryozoans.

The nest of the bokmakierie (bottom middle) shows the handiwork of both sexes, with its neat, open-cup design, a common shape for perching birds. The light-vented bulbul's nest (centre), similarly crafted, is largely made from twigs and bamboo leaves. It is in its original shipping packaging from 1896.

The multiple open-cup nests (near left, bottom) are the work of many different birds, but have all been commandeered by the common cuckoo, which lays its eggs in the nests of more than 100 other bird species worldwide.

In his new book *Interesting Bird Nests & Eggs*, in which all these images appear, Douglas Russell, senior curator at the museum, delves into the history of some of the specimens. "A nest is a captured piece of the environment, a moment in time," he says. "You couldn't ask for a more comprehensive little, tiny, feathered botanist to take up that little sample of material for you." ■

Obomate Briggs

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**BMW
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How companies drive decarbonisation

The automotive industry faces the twin challenge of decarbonising while helping to make urban transport cleaner, safer and more sustainable. The solution is collaboration, flexibility and building consensus, says BMW Group

On a warm summer afternoon in a converted warehouse in the heart of London's Covent Garden, executives from the German carmaker, BMW Group, are meeting with community leaders, academics and entrepreneurs to discuss sustainability and the goal of making cities more liveable. Their motives are clear. "As a company we are part of society," says Alexander Bilgeri, a vice president at BMW Group. "That's why we need to be part of the solution."

Society is broadly agreed on the goal of achieving net zero carbon emissions by 2050. The big question is how to do it while managing the complexities of industrial manufacturing and the transformation of society. During the 2024 London Climate Action Week, BMW Group organised this meeting to better understand these issues, share solutions and build consensus.

For companies, perhaps the biggest immediate challenge is to decarbonise the way their products are used, the way they are made and, most complex of all, to decarbonise the supply chains that contribute to production.

The automotive industry exemplifies this challenge. About three-quarters of the industry's carbon footprint comes from the product "use phase". In other words, burning fossil fuels in internal combustion engines as the vehicles are driven. This footprint is expected to shrink in the next few years as electric vehicles (increasingly powered by renewable energy) gain popularity.

So the focus is now shifting to the production phase—how to decarbonise the process of building vehicles. BMW Group is aiming to reduce this in stages and has set itself the initial goal of lowering carbon emissions by 40 per cent per vehicle by 2030 throughout the entire value chain.

This means improving energy efficiency in

factories and warehouses, reusing and recycling materials, and embracing circularity. This is a challenge, but the complexity is manageable as it only requires internal measures and decision-making processes, says Hendrik Lang, Senior Vice President Strategy, Digitalisation and Sustainability, at the Purchasing and Supplier Network of BMW Group.

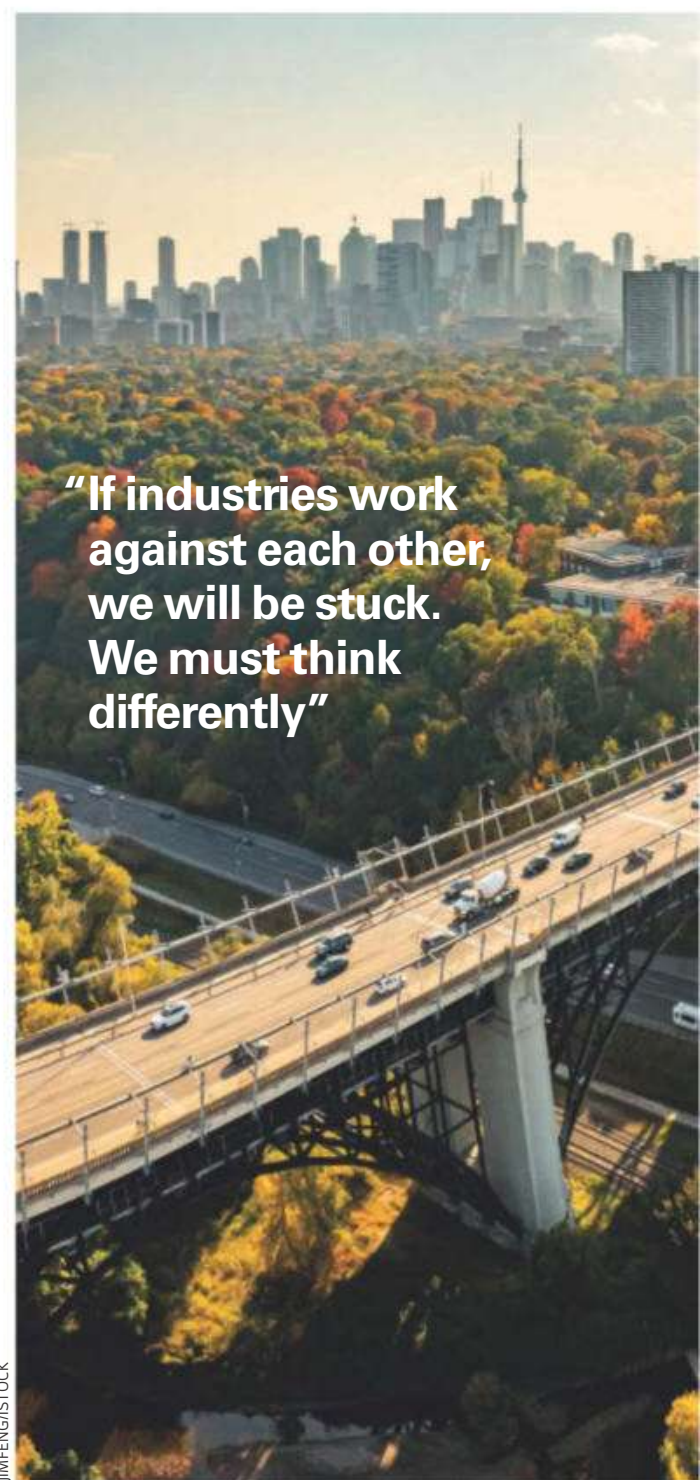
A tougher challenge is decarbonising the company's supply chain and making it more sustainable. "The automotive supply chain is one of the most complex in the world," says Lang. BMW Group, for example, has around 2700 direct suppliers and hundreds of thousands of suppliers further down the supply chain. Ensuring they all work towards the same decarbonisation and sustainability goals is a Herculean task.

But it is achievable through collaboration on an unprecedented scale. "If industries work against each other, we will be stuck," says Bilgeri, who is VP of Communications Human Resources, Production, Purchasing and Sustainability at BMW Group. "We must think differently."

Lang points to how BMW Group has transformed the recycling of aluminium parts. Certain parts, like wheels, can be produced using up to 70 per cent recycled aluminium. But suppliers were using mostly virgin metal because there was not enough recycled feedstock from automotive parts.

So BMW Group worked with suppliers of aluminium parts to develop an alloy with new specifications which fulfils all technical requirements while at the same time using a high percentage of recycled material from non-automotive sources. BMW Group will now work with suppliers and industry players to make this new alloy an industry standard, so higher percentages of recycled aluminium can be used by other manufacturers as well.

BMW Group's Alexander Bilgeri (right) leads discussions on the future of sustainable transport



"If industries work against each other, we will be stuck. We must think differently"

JIMFENG/ISTOCK



New technology is also playing a key role in reducing automaker carbon emissions. BMW Group has become a driving force in setting up Catena-X, an industry-wide data ecosystem that allows automotive companies and suppliers to share data, including the carbon footprint of their products. The goal is to make it easier to cooperate to reduce carbon footprints across the entire supply chain.

Even greater gains can be achieved by switching suppliers to renewable power sources. For example, steel and aluminium manufacturing is carbon intensive because of the energy required to smelt metal ore, which currently comes from burning fossil fuel. Switching to renewable energy sources is an obvious move but one that requires significant long-term investment in power infrastructure from governments, utility companies and taxpayers.

That's relatively straightforward in richer economies that have placed a high priority on net zero. But carmakers also operate in regions with governments that have other priorities. "Geopolitics introduces much complexity," says Bilgeri. "You have to explain the goal and set out the vision, but there's no easy solution."

However, BMW's commitment to sustainability isn't limited to advanced economies. In South Africa, for example, the Ntsha-Peu Primary School educates young people in Soshanguve, a multiethnic township of almost a million people near Pretoria. BMW Group provides financial support for the school and also made it home to the company's PowerUp pilot project that recycles batteries from development vehicles to store solar power from the roof of the school. This helps maintain consistent levels of learning, even during blackouts.

But this isn't an entirely altruistic effort, Bilgeri admits. BMW Group builds BMW X3 electric cars in the area, which requires an educated workforce. "If we don't help provide education, we will not have people who can build our cars or manage our plant," he says.

And there's an even bigger picture. Bilgeri argues that a more educated society is more likely to be stable. And a stable society provides a better environment in which to make cars. "We believe it creates a business advantage," he says. "The bottom line is that BMW Group is woven into society so we share the same interests."

More at: www.bmwgroup.com

LIVEABLE CITIES

More than half the world's people live in cities, and the numbers are rising. This trend raises important questions about making urban areas more liveable and sustainable, particularly concerning the evolution of transport and how people interact with it.

BMW Group is developing a strategy to better understand the future of urban mobility, focusing on traffic and urban space management, charging infrastructure, parking solutions and improving conditions for multimodal travel mobility choices.

"The question that motivates us is the sustainability of the use phase of our product. It is about the footprint that our customers leave and how they interact with the environment in cities," says Thomas Becker, Vice President Sustainability and Mobility Strategy. "Electrification is crucial to this future. But you have to convince people to buy a product that is different from the ones they are used to, and which also depends on an infrastructure that is not provided everywhere."

Reducing congestion and efficient usage of public space is also key to improving the liveability of city centres. City authorities view investment in public transport, car sharing and taxis as essential strategies, alongside promoting cycling and scooting. The truly successful measures are those that are accepted by the inhabitants and reflect their mobility needs. "Combining the experience of industry with the strategic planning of city administration can result in a win-win situation for all players," says Becker.

Alexander Bilgeri of BMW Group says: "We have to respond to technological and social changes." The goal for him, Becker and colleagues is to understand how BMW Group fits into the sustainable future of urban mobility. Becker concludes: "There will certainly be more integration of other forms of transport in urban areas but the private car will continue to play an important role in mobility."



The moral of the story

How do we work out right from wrong? A gripping anthropological account argues imagination and differing senses of the world are key, says **Simon Ings**



Book

Animals, Robots, Gods

Webb Keane

Allen Lane

NO SOCIETY we know of ever lived without morals. Roughly the same ethical ideas arise, again and again, over time and in different societies. Where do these notions of right and wrong come from? Might there be an ideal way to live?

In *Animals, Robots, Gods: Adventures in the moral imagination*, anthropologist Webb Keane at the University of Michigan argues that morality doesn't arise from universal principles but from the human imagination. For him, moral ideas are sparked in the friction between objectivity, when we think about the world as if it were a story, and subjectivity, in which we are in some sort of conversation with the world.

The classic trolley problem elucidates Keane's point. If you saw an out-of-control tram car hurtling towards five people and could pull a lever that sent it down a different track, killing only one innocent bystander, you would probably flip the switch.

If, on the other hand, you could save five people by pushing an innocent bystander into the path of the trolley (using them, in Keane's phrase, "as an ad hoc trolley brake"), you would probably choose not to interfere. The difference in your reaction depends on whether you are looking at the situation objectively, at some mechanical remove, or subjectively imagining yourself in the thick of the action.

What moral attitude we adopt to situations depends on how socially charged we think they are. I would happily kick a stone



STEFAN LENZ/GETTY IMAGES

down the road; I would never kick a dog. Where, though, are the boundaries of this social world? If you can have a social relationship with your pet dog, can you have one with your cancer tumour? Your god?

Keane says that it is only by asking such questions that we acquire morals in the first place. And we are constantly trying to tell the difference between the social and the non-social, testing

"We cannot make sense of ethics without understanding what makes them feasible ways to live"

connections and experimenting with boundaries, because the question of what makes a human lies at the heart of all morality.

Readers of *Animals, Robots, Gods* will encounter a wide range of non-humans, from sacrificial horses to chatbots, with whom they might conceivably establish a social relationship. Frankly, it is too much content for so short a book. Readers interested in the

ethics of artificial intelligence, for instance, won't find much new insight here. On the other hand, I found Keane's distillation of fieldwork into the ethics of hunting and animal sacrifice both gripping and provoking.

We also meet humans maintained by technology. Keane reports on a study by anthropologist Cheryl Mattingly in which devout Christians Andrew and Darlene won't turn off the machines keeping their daughter, who has been diagnosed as brain-dead, alive.

The doctors believe that, in the effort to save her, their science has cyborgised the girl to the point at which she is no longer a person. The parents believe that, medically maintained or not, conscious or not, their child being alive is significant and sufficient to make her a person.

This is hardly some simplistic battle between religion and science. Rather, it is an argument about where we set the boundaries within which we apply moral imperatives like the one telling us not to kill.

Morals don't just guide lived

The trolley problem is a classic dilemma in moral philosophy

experience – they arise from personal experience. There can be no trolley problems without trolleys. This, Keane argues, is why morality and ethics are best approached anthropologically. "We cannot make sense of ethics, or expect them of others, without understanding what makes them inhabitable, possible ways to live," he writes. "And we should neither expect, nor, I think, hope that the diversity of ways of life will somehow converge onto one 'best' way of living."

We communicate best with strangers when we accept them as moral beings. A Western animal rights activist would never hunt an animal. A Chewong hunter from Malaysia wouldn't dream of laughing at one. If these strangers really want to get the measure of each other, they should each ask the same, devastatingly simple question: just which bits of the world feel human to you? ■

Simon Ings is a writer based in London



Eleanor Parsons
Chief subeditor
London, UK

I have just read **Systemic: How racism is making us ill** by Layal Liverpool. A thoroughly researched, beautifully written book, it weaves together personal experience and interviews with devastating statistics.



Liverpool, who used to work at *New Scientist*, methodically lays out how racism can harm people's health, from the damage that the stress of experiencing it does to the body to how training images of skin conditions are disproportionately of pale skin types. She also dismantles the use of "race adjustments" in some medical test results and shows how they reinforce systemic racism. Essential reading.

For a change of pace, I enjoyed the **Yayoi Kusama: 1945 to now** exhibition at the Serralves Museum in Porto, Portugal, on until 29 September. I particularly love her works inspired by nature, like her spotty tentacle sculptures and colourful paintings that remind me of cells.

Imagine my delight when, back in London, I found a giant pumpkin created by Kusama in Kensington Gardens!

Going deeper

Despite some hype, a new nature series about ocean life delivers on the visuals, finds **Josh Bell**



TV
OceanXplorers
National Geographic
Disney+

WITH the prominent X in the middle of its title, *OceanXplorers* sounds like something from the 1990s trend of making "extreme" versions of familiar things to draw in younger people.

Host and executive producer James Cameron adds to that feel as he opens each episode of the documentary series by touting the "kick-ass team of insanely talented specialists" who work on "the most technologically advanced research vessel ever built" – like they are the stars of a *Mission: Impossible* movie. Of the four regulars, only two are marine scientists, while one is ex-military, having been a Royal Marine, and another is an "ocean technology innovator".

Beyond its try-hard, high-tech trappings, *OceanXplorers* is a pretty straightforward nature series, and that is no bad thing.

The OceanXplorer team work together to tag a Greenland shark

It is co-produced by the BBC Studios Natural History Unit and private ocean research company OceanX (which owns the ship), and it lives up to the BBC's high standards of cinematography. The main draw isn't Cameron's celebrity or the "insanely talented" research team, but the animals and stunning footage on show.

Each episode sends the OceanXplorer ship on a different mission, mainly focused on studying sharks and whales, with guest experts to augment the core cast members. Those missions almost always involve attaching sensors or cameras to various animals, which can make the tech marvels seem repetitive and mundane. The low point is any time the team gathers in the Holo Lab, an augmented-reality facility requiring cumbersome headsets that just show the same kind of graphics that could be shown on a regular screen.

The most charismatic team member is shark biologist Melissa Cristina Márquez, whose enthusiasm for knowledge is infectious. While the series promotes the discoveries that the team is making to the point of sounding overblown, when Márquez exclaims "This is probably

a first for science!" it is easy to believe that her excitement is real.

Whether or not the OceanXplorer team is actually making more progress than other scientists isn't that relevant for the show's entertainment and information value. Viewers are more likely to be awed by a hammerhead shark hunting a stingray or a swarm of boarfish around the OceanXplorer submersible than they are by incremental achievements in gathering data. Each episode features at least one such striking image, and even seasoned nature documentary fans should find something new to appreciate.

Cameron fans may be slightly disappointed, since his association is perfunctory. He may be a National Geographic Explorer at Large, but he never interacts with the team or goes on any of the expeditions, and it wouldn't be surprising if his host segments were shot in a single day. In an episode featuring the team studying bluntnose sixgill sharks, Cameron mentions his own encounters with the long-lived creatures, but anyone looking to see the legendary filmmaker go on explorations of his own will have to watch one of the documentaries he directed himself.

As a narrator, however, Cameron is perfectly serviceable, and he adds extra urgency to the pleas for environmental preservation that increase as the series progresses. Like many recent nature films, *OceanXplorers* puts climate change to the fore, and the finale, when the team studies polar bears on the shrinking ice of Svalbard in Norway, offers a stark illustration of its effects on animal behaviour and survival. This leaves a more lasting impression than flashy tech or "kick-ass" adventuring. ■

Josh Bell is a writer and critic based in Las Vegas, Nevada



MARIO TADINAC/NATIONAL GEOGRAPHIC

The sci-fi column

High stakes For an undercover operative, Sadie Smith takes unnecessary risks as she infiltrates an eco-activist group. Why? And where do the Neanderthals fit into this gripping climate-fiction novel? **Emily H. Wilson** loved finding out



Emily H. Wilson is a former editor of *New Scientist* and the author of the *Sumerians* trilogy, set in ancient Mesopotamia. Her second book in the series, *Gilgamesh*, is out now. You can find her at emilyhwilson.com, or follow her on X @emilyhwilson and Instagram @emilyhwilson1



PHOTONONSTOP/ALAMY

The action in *Creation Lake* is based in Guyenne in south-west France

man's emails, that becomes the beating heart of the book.

Sadie has hacked into Le Moulin's group email account so she can read every message they get from someone named Bruno Lacombe. He is a mentor and inspiration to the group, and it makes sense that she pays his emails particular attention.

In the messages, Bruno talks about his views on the superiority of Neanderthals, the inferiority of *H. sapiens* and his life living alone in a Neanderthal cave. He also lectures the Moulinards on the history of the Guyenne area.

As a plot device, these emails have every right not to work. But we quickly learn to read them intently, just as Sadie does. Soon we realise that it is the relationship between Sadie and Bruno (albeit a relationship only she knows about) that is at the emotional centre of the novel.

She is more interested in him and what he has to say than any of the Moulinards are. Might she run into him before her operation in France is over?

I found Bruno's musings on the Neanderthals, however biased and unscientific, particularly gripping – perhaps because I read them while on a *New Scientist* tour of the prehistoric art of northern Spain. The oldest artwork there is believed to be by Neanderthals, and however different (or not) they were from us, Bruno's passion is evocatively captured.

I can't say any more without spoiling the high-octane plot. As for Sadie, does she deserve our sympathy, and where do the book's events leave her as a person? I look forward to reading this again, and perhaps puzzling that out. ■



Book

Creation Lake

Rachel Kushner
Jonathan Cape (UK, 5 September); Scribner (US, 3 September)

Emily also recommends...

Book

The Ministry for the Future

Kim Stanley Robinson
Orbit

Creation Lake is arguably climate fiction. But if you want the ultimate in cli-fi, then read The Ministry for the Future. The book plays out a scenario that is almost upon us as the world heats up. Its structure, made up of fictional eye-witness accounts, is bold and relentlessly brilliant.

CREATION LAKE by Rachel Kushner is a thriller, a spy caper, a comedy and also a poetic take on human history all the way back to the time our species, *Homo sapiens*, shared Earth with the Neanderthals. It is a sensationally enjoyable novel and has deservedly made the Booker prize longlist.

The story is narrated by our anti-hero, Sadie Smith (not her real name). She is a US undercover operative working for shady employers who is sent to France to infiltrate and ultimately destroy Le Moulin, a group of eco-activists whose members are known as Moulinards.

Sadie sets about her task in an entirely amoral fashion. First, she seduces a man named Lucien who has contacts within the activists. After a few months, she has secured work among the Moulinards and travels to Lucien's family house, conveniently placed in an area of Guyenne, south-west France, where Le Moulin is based.

The roof leaks, but the house itself is a great eyrie to spy upon her prey from – a job made easier by her high-powered, military

grade binoculars and a caseful of high-tech kit.

The novel's structure is brilliant. We follow Sadie as she worms her way into the justifiably paranoid Moulinard community. We are also led backwards through her life, rifling through her backlist of operations and lingering resentments against those who

“The third strand, relating to a much older man's emails, becomes the beating heart of the book”

are attempting (rightly) to expose her. We gradually realise our apparently super-professional operative takes unnecessary and dangerous risks. Is she, in fact, a vulnerable young woman hanging by a thread, or a grenade with the pin pulled out? Or both?

These two strands, moving forwards and backwards, are equally gripping, each informing the other with perfect dramatic timing. But it is the book's third strand, relating to a much older

Editor's pick

Terraform Mars? That's a definite no

17 August, p 16

From Bryn Glover, Kirkby

Malzeard, North Yorkshire, UK

I noted that Alex Wilkins left the most important question to the final sentence of his piece on terraforming Mars: should we? Well, of course not. The urge to spread destructive humanity across the cosmos is merely the 21st-century equivalent of European explorers seeking to solve the problems of overexploited Europe by conquering new lands. We should be concentrating all our efforts on devising ways to exist on this one planet in total harmony and equilibrium for the entire foreseeable future.

Sedentary childhood: the problem is the parents

22 June, p 31

From Guy Cox, Sydney, Australia

Good to see the hype about screen time deflated and the question of a more sedentary childhood dealt with. A missing factor is restrictive parenting. When I was a child under 10 (early 1950s), I was totally free to roam the streets or the countryside with my friends. Nobody questioned it and you can't have a sedentary lifestyle if you are out there having fun.

The thought of today's children going out in the streets without an adult seems inconceivable. Why? There are no more dangers than when I was young. Parents, not screen time, are the problem.

Roast dodo? It was revolting, apparently

Letters, 3 August

From Martin van Raay,

Culemborg, Netherlands

Charles Joynson asks whether bringing back the dodo will put the bird on the menu. That isn't very likely, I guess. In 1974, Dutch author Jan Wolkers published his

novel *De Walgvogel*. The title refers to the dodo, which Dutch sailors found on Mauritius and hunted for food. They found the flesh not very tasty. "Walgvogel" translates to "disgusting bird". So it is unlikely the dodo was eaten to extinction by humans.

We lack knowledge to fully assess human family tree

3 August, p 32

From David Marjot,

Weybridge, Surrey, UK

Modern palaeoanthropology and archaeology can be misleading, I would suggest, and classification of "post-primates" like us and "prehistoric man" is confused.

As we devise post-primate species and genus from a scattering of bones and stones, we can't see speech or family structures and dynamics that may be more significant in our classifications. Also, "primate" features among *Homo* of earlier varieties or species means we will put them at an earlier or more primitive phase in human development. The post-primates we are studying may well have had many different forms, hence confusion will be endemic.

We lack the knowledge to be able to offer a sound classification and understanding of human and putative post-primates.

A better measure of fairness in sport

Leader, 3 August

From Donald Windsor,

Norwich, New York, US

The universe is abnormal, in that measurements of most things don't fit a normal curve, where the mean (average) and the median (typical) are the same. So your editorial's claim that it is "unfair"

that bigger countries win more medals is irrelevant. Perhaps a metric such as medals per million people would be better.

Get scrubbing to get your exercise

27 July, p 32

From Andrew Smith,

Leongatha, Victoria, Australia

Scanning "The smarter way to a fitter you", I discovered a comprehensive account of most aspects of exercise. However, apart from home-based game playing and pedometer measures, there was no mention of domestic work.

There seemed to be a theme of avoiding boredom in exercise pursuits, and maybe that is why domestic activity wasn't featured. Getting out of sitting or prone positions to do cleaning, tidying up, attending to pets or plants regularly is good for health. In fact, a recent British Medical Council study of 4563 Northern Ireland adults found that many of them met or exceeded the UK standard of moderate to vigorous physical activity thanks to domestic work.

No real chance of time flowing backwards

Letters, 20 July

From Derek Bolton,

Sydney, Australia

Dave Johnson wonders if time can flow backwards in some small pockets of space, given increasing entropy equates with time's arrow. This shows how intuition fails with huge and tiny numbers. When two atoms bounce off each other elastically, their energies tend to be more equal afterwards (increased entropy). When, by chance, they are less equal, it means there has been a tiny reduction in entropy. But the

odds that the total entropy of many such atoms would detectably decrease grows rapidly smaller as the number of atoms increases, soon becoming unlikely in several universe lifetimes.

In favour of weight-loss drugs for older children

6 July, p 8

From Ekene Moses, London, UK

When I read that the American Academy of Pediatrics was recommending weight-loss medication for children aged 12 and up, my moral stance on this initially made me cringe. However, after completing the article, I support this idea despite reading contradictory advice from the US Preventive Services Task Force, which cites insufficient evidence and suggests long-term studies. The covid-19 vaccines have proven that if the good of treatment outweighs the potential harm, use shouldn't be precluded.

Let's call it what it is: so-called AI

27 July, p 17

From Michael Crowe,

Canberra, Australia

As the article "Super AI is still sci-fi" noted, the term "artificial intelligence" is little more than a good branding exercise. This is much more attractive to investors than using facts about machine learning pattern recognition algorithms with more powerful graphics processing units. When it comes to "AI", there is nothing approaching "intelligence", so why not flag this as "so-called AI"?

Try kangaroo to cut livestock methane

10 August, p 16

From Barry Cash, Bristol, UK

A vaccine to stop cows burping methane is very ingenious. But wouldn't it be simpler to farm animals that eat grass and don't burp or fart much methane? They are called kangaroos. ■



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Overcoming dementia

A tranche of new drugs finally points the way to treating – and perhaps even eliminating – Alzheimer’s disease, reports **Graham Lawton**

“**I** HAVE really modest goals. I want to have the largest impact on human suffering of anyone, ever,” says Lou Reese, co-founder of biotechnology company Vaxxinity. He might just pull it off. If everything goes to plan, by 2030 the firm will offer a new drug that will revolutionise our approach to one of the world’s most feared diseases, and may even lead to its eradication.

That disease is Alzheimer’s, the most common form of dementia, which causes untold pain to people and their relatives. It and other forms of dementia are seen as a ticking time bomb ready to blow up in the brains of an increasingly elderly population.

But now it seems there may be a way to defuse this problem. Vaxxinity, which is based in Cape Canaveral, Florida, is working on vaccines designed to halt the progression of Alzheimer’s or even stop it from developing in the first place. Several other companies are in the same game and the approach is showing great promise. “Society is entering an era in which the unchecked devastation of Alzheimer’s disease is no longer inevitable,” says Dennis Selkoe at Harvard Medical School.

Around 55 million people are living with dementia and that number is projected to rise to about 140 million by 2050, with disastrous consequences for patients, their families and our health and social care systems. In 2021, the World Health Organization estimated that the global cost of dementia could reach almost \$2.8 trillion by 2030.

There are various types of dementia, but Alzheimer’s accounts for the lion’s share, at 60 to 80 per cent of cases. It is a

neurodegenerative condition that destroys the brain and causes people to gradually lose their memories, personalities and independence. As Auguste Deter, the first person diagnosed with the disease, told her doctor Alois Alzheimer, in 1901: “I have, so to speak, lost myself.”

Until recently, little could be done to help people with Alzheimer’s find themselves again. Untold numbers of experimental therapies showed initial promise but fell by the wayside. There are a handful of established drugs on the market, but they barely slow the progression of the disease, let alone cure it.

Plaques and tangles

To truly defeat this condition, we need to know what causes it. There have been clues since Alzheimer’s was first described in the early 1900s by the eponymous German psychiatrist while treating Deter. After she died in 1906, Alzheimer dissected her brain and discovered it was riddled with sticky, abnormal protein deposits between neurons and tangles of proteins inside them. The deposits, or plaques, became – and remain – the defining feature of the disease. In the 1980s, various researchers discovered they were formed of a previously unknown protein they named beta-amyloid. The intracellular tangles, meanwhile, were composed of a modified form of a known protein called tau.

These discoveries led, in 1992, to the amyloid cascade hypothesis. Beta-amyloid normally exists as a soluble and useful protein in the brain, but the cascade hypothesis posits that the key event in Alzheimer’s disease is

abnormal aggregation of the protein into solid plaques. This then triggers the formation of tau tangles, leading to the dysfunction and death of neurons. Exactly what initiates this cascade is largely unknown. Nonetheless, this quickly became the leading hypothesis for the cause of Alzheimer’s disease.

Pharmaceutical firms soon began experimenting with small-molecule drugs designed to target beta-amyloid and break it down. Between 2001 and 2021, dozens of compounds entered clinical trials, yet none made it out alive: they didn’t work, had toxic side effects, or both. As a result, the amyloid cascade hypothesis fell out of favour, prompting researchers to propose various other causes and mechanisms.

For instance, the pathogen hypothesis suggests the true root cause is bacteria getting into the brain, with the plaques being an immune overreaction to the infection. We know that tau proteins cause neuroinflammation – an immune flare-up that damages neurons – so another line of thought is that this is what we truly need to combat. These hypotheses are not mutually exclusive. But still, there has been plenty of disagreement over how Alzheimer’s really works. Selkoe describes it as a set of “roiling scientific controversies”.

Now, a new line of research is quieting those controversies. There has been a shift towards using the immune system itself to attack the amyloid plaques. One way to accomplish that is with vaccines. The most familiar vaccines are those used to ward off infectious diseases, which largely work by prompting the



DANIEL GARCIA



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immune system to make antibodies against the intruder. However, vaccines can also be made to target troublesome proteins such as beta-amyloid.

This idea isn't new. In 1999, scientists at Elan Pharmaceuticals developed a vaccine against beta-amyloid and demonstrated that it cleared the protein in a mouse that had been genetically engineered to have Alzheimer's-like symptoms. They also developed a monoclonal antibody – an injectable antibody made in a test tube – which had the same effect. Both these immunotherapies were rushed into human trials. Neither worked.

Nevertheless, the concept lived on and success finally arrived three years ago in the form of a monoclonal antibody developed by biotechnology company Biogen, based in Cambridge, Massachusetts. It works by binding to toxic aggregates of beta-amyloid, prompting immune cells to gobble them up. In June 2021, the US Food and Drug Administration (FDA) approved the drug. Aducanumab became the first Alzheimer's drug to win approval since 2003.

Biogen has now abandoned aducanumab for what it says were non-medical reasons in favour of a similar monoclonal antibody called lecanemab, which it developed alongside Japanese firm Eisai. In clinical trials, this drug produced significant reductions in cognitive decline in most – but not all – of the participants. Likewise, it reduced the decline in their ability to live independently. Last year, the FDA approved it for use in people with early-stage Alzheimer's. Another amyloid-busting monoclonal, Eli Lilly's donanemab, was also granted FDA approval in July.

According to immunologist Marie Kosco-Vilbois at biotech company AC Immune in Lausanne, Switzerland, the success of these drugs was a watershed moment. "Donanemab and lecanemab finally proved that if you pull out plaque, it will be associated with rescue of cognitive decline," she says. "That's definitely proven."

Monoclonals appear to have succeeded where small molecule drugs failed and there are various possible reasons why. It could be that those earlier drugs simply didn't effectively bind to amyloid. The monoclonals are also more specific, targeting only the amyloid in plaques rather than the natural, soluble form of the protein, which has important biological functions in the brain.

Monoclonal antibodies are far from perfect, however. They disintegrate fairly swiftly in

the body, so lecanemab has to be infused intravenously for about an hour once every two weeks. It isn't cheap, either, at \$26,500 per patient per year. Worse, a significant proportion of those taking it develop serious swelling or bleeding in the brain, or both. In the large-scale, phase III trial of lecanemab, 12.6 per cent of patients were diagnosed with these side effects. For donanemab, the number was 24 per cent. These are enormous drawbacks, says Reese. "Tell me that you're going to take a very expensive treatment that takes hours for infusion, that may or may not be slowing the progression of the disease and has a three-out-of-ten chance of causing drug-induced brain swelling?" he says. "Perfect!"

As if to underscore this point, the European Medicines Agency decided in July not to green-light lecanemab on the grounds that the small gains it can bring don't outweigh the risk of serious side effects. Biogen has since appealed the decision.

Nonetheless, Reese says he is a "big fan" of the monoclonal approach because it is opening a new frontier in the treatment of Alzheimer's. The monoclonals have shown that eliminating amyloid can alleviate symptoms and hence that it is a cause of the disease. "The amyloid-beta theory is more or less proven by these antibodies," says Kosco-Vilbois.

This suggests that the other previously

"The outright prevention of Alzheimer's has become a realistic goal"

Vaccines could one day stop people ever experiencing dementia



JEFFREY ISAAC GREENBERG 3+/ALAMY

attempted approach – when Elan Pharmaceuticals had a stab at creating an Alzheimer’s vaccine – could be a goer after all. Several companies have been working on this and there are now four vaccines targeting beta-amyloid in clinical trials. The most advanced is Vaxxinity’s UB-311, which is poised to go into a phase III clinical trial and could be available for use by 2030. The vaccine generates antibodies against toxic aggregates without touching the normal form of beta-amyloid and is designed to be given to people diagnosed with mild Alzheimer’s. A phase II clinical trial in Taiwan showed that the vaccine is safe and generates a strong immune response. It also slowed cognitive decline by about 50 per cent on average, says Mei Mei Hu, chief executive of Vaxxinity, which is about twice as effective as lecanemab.

There are reasons to believe that vaccines will outperform monoclonal antibodies. Monoclonals are “passive immunotherapies” – they don’t engage the immune system, but merely flood the bloodstream with short-lived antibodies. Vaccines, on the other hand, are active immunotherapies that stimulate the immune system to make its own antibodies. This approach seems to have many advantages. So far, there has been no sign of brain swelling or bleeding with UB-311, says Hu. For reasons unknown, the antibodies it induces appear to be two to three times more efficient at crossing the body’s protective blood-brain barrier. Vaccines are also cheaper than monoclonals and far simpler to administer. Patients would initially receive four or five injections in the space of a year, then one or two boosters a year thereafter.

Despite widespread optimism about the vaccines, there is always a risk that they will come to grief in late-stage clinical trials through lack of effectiveness, intolerable side effects, or both. Time will tell.

One reason for hope, though, is that there are several ways to deploy the power of vaccines against Alzheimer’s. There are also vaccines in development against the other villain of the piece, tau tangles. According to the amyloid cascade hypothesis, these are the direct cause of neurodegeneration.

Tau, however, is a tougher nut to crack than beta-amyloid because it is found inside rather than outside cells, meaning that antibodies normally can’t access it. That is probably why experimental anti-tau monoclonals have all failed, according to Selkoe. But there is a way



KATERYNA KON/SCIENCE PHOTO LIBRARY

Beta-amyloid proteins around neurons are a key sign of Alzheimer’s

to sidestep this problem. According to Kosco-Vilbois, tau tangles eventually spill out of neurons and become visible to antibodies. This extracellular phase, which is partly responsible for neurodegeneration, should be treatable. AC Immune has an anti-extracellular tau vaccine, ACI-35.030, in a phase II clinical trial. And even if tau vaccines don’t work brilliantly on their own, they could be part of a multi-pronged attack combining vaccines that target different parts of both rogue proteins. “We can go after multiple targets at one time,” says Reese.

Dampening inflammation

Although we now know that beta-amyloid has a causative role in Alzheimer’s, there are other physiological consequences of the disease that immune therapies could tackle. It is clear, for example, that plaques and tangles cause neuroinflammation, and emerging evidence suggests this has a significant role in the development of Alzheimer’s.

Howard Weiner at Harvard Medical School is focused on this. He and his team are trialling a monoclonal antibody called foralumab, which was designed to treat multiple sclerosis and Crohn’s disease. It stimulates a protein cluster, CD3, found on the surface of immune cells known as regulatory T-cells. The drug is administered nasally, which delivers it to lymph nodes in the neck. When the antibody

latches on to CD3, it activates T-cells, which then migrate into the brain and damp down inflammation. It has been shown to reduce symptoms in a mouse model of Alzheimer’s and was recently cleared to begin human trials. The nasal route has advantages over intravenous infusions of monoclonals. “The T-cells naturally go into the brain, so you don’t have to worry about crossing the blood-brain barrier,” says Weiner.

All this progress on multiple fronts suggests we could be entering a new era where people who develop early-stage Alzheimer’s are no longer staring at inevitable decline into the abyss. “Do I think that stimulating the immune system will work in Alzheimer’s?” says Weiner. “I think the answer is definitely yes.” The benefits could extend to different kinds of dementia, too, many of which are associated with rogue proteins that could be the target of a vaccine.

There may be an even greater prize on the horizon. A blood test invented a few years ago can pick up traces of abnormal tau tangles 20 years before any symptoms of Alzheimer’s appear. So the hope is that we could give individuals such a test and vaccinate anyone that requires it, nipping the disease in the bud. “The outright prevention of Alzheimer’s disease has become a realistic goal,” says Selkoe.

AC Immune’s anti-tau vaccine is testing this tantalising possibility. The volunteers in the trial haven’t been diagnosed with Alzheimer’s or even its precursor, mild cognitive impairment, but they have been identified via the blood test as being at high risk of developing the condition. Volunteers who are picked up by this test are further screened with a PET scan to confirm that they have abnormal tau in their brains and, if they do, are given the tau vaccine.

Does this raise the prospect that Alzheimer’s can be eradicated? Reese, for one, says it absolutely can be. “I think of it like polio,” he says. “Almost no one in our generation has been personally afflicted by the suffering of polio. It’s my goal that our kids’ and our grandkids’ generations have that same foreignness and historical understanding of Alzheimer’s and the suffering that it brings.” ■

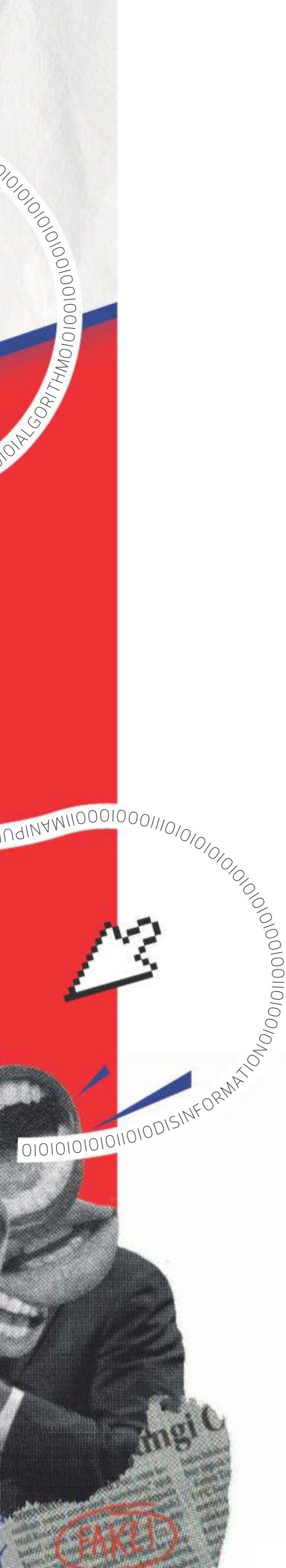


Graham Lawton is a staff writer at *New Scientist*

The truth about digital propaganda

How worried should we be that online manipulation is undermining democracy?
Researchers **Kate Dommett** and **Tom Stafford** have some surprising answers





MONSTERS loom, threatening our democracies. They come in many guises, from online misinformation networks and deepfakes to social media bots and psychological microtargeting that uses our personal data to tailor political messages to our interests, attitudes and demographics.

With around half the world's population going to the polls in 2024, democracy might seem to be in good health. Yet many worry that it is being undermined by powerful new digital technologies with the potential to target individuals, manipulate voters and sway elections. Fears of digital influence derive some of their power from the novelty of the technologies – we aren't long into the online age and nobody fully understands what is happening now, let alone where things are going. Each new technology feels unfamiliar and can leave us sensing that the rules of the game are being rewritten. But are these concerns justified?

We are among a growing number of researchers with expertise in political science and psychology who are attempting to draw these monsters out of the shadows. Our studies aim to find out how the new technologies are being used and by whom, as well as how effective they are as tools of propaganda. By carefully defining the idea of digital manipulation, we now know more about the threat it poses to democracy than ever before. There is a vocal lobby that warns about the dangers, but our studies point to a more surprising conclusion. What's more, our findings can better prepare societies to face the digital demons, telling us exactly what we should be worried about – and what is merely a spectre of our imaginations.

The UK's 2010 general election was called "the first social media election". Things have changed rapidly since then. Now, in democracies around the world, it is impossible to imagine parties and politicians campaigning without Facebook ads, TikTok accounts, YouTube videos and WhatsApp channels for supporters. Digital tools have multiple uses. They help raise awareness, bolster pre-existing support and attempt to persuade. But they can also be used to spread misinformation, discourage people from voting and fuel cynicism and discontent.

An important goal of the new science of digital politics is to uncover exactly what political campaigns are doing. Analysing online content is by no means simple: there isn't a single archive of data and many online spaces are almost impossible to study systematically. However, we do have good access to information on paid-for political

advertising – one of the key digital tools linked with microtargeting, misinformation and foreign interference. This shows that online ads are being widely used, with around £7.5 million spent by political parties on Facebook and Google at the 2019 UK general election and a whopping \$150 million spent on digital ads by candidates during federal races in the 2022 US midterms. But high spending doesn't necessarily mean campaigners are engaging in digital manipulation. The next challenge is to figure out the impact these new technologies are having on us.

There is a common perception that digital media tricks voters. This idea has been topical for more than a decade, largely originating from the revelation that a company called Cambridge Analytica was using Facebook data about individuals, without their consent, to sell its services to political campaigns. According to its sales pitch, the firm could understand individuals' personality types and use them to craft personalised messages to influence their voting. It has never been clear whether Cambridge Analytica could target voters accurately, or the extent to which targeting drove the online adverts it helped deliver. Despite this, it is still widely feared that unknown actors can use personal information available online to control our minds, framing messages that make us dance like unconscious puppets on the strings of our vulnerabilities.

Targeting voters

Luckily, there is a rich body of evidence that can help estimate the likely extent and influence of digital manipulation. It indicates that people's personal data is indeed routinely used by political parties, but microtargeting is surprisingly limited, given the wealth of online information available about our interests, personalities, hobbies, political views, background, demographics, status and social networks. One recent study of 113 national elections in 95 countries found that most campaigns use just one targeting criterion – commonly age, gender or location – when placing adverts. In only a small number of countries did campaigns routinely use four or more targeting criteria. Looking at several well-established democracies, our own work has shown that campaigners tend to target messages at certain electorally important constituencies or at men or women in specific age groups, rather than niche audiences.

Even if microtargeting isn't as common as we might at first believe, online political adverts could still influence how we vote. Over the past few years, researchers have sought ➤

RYAN WILLS

to determine whether this is the case – and they have repeatedly shown that the impact of this type of advertising is small. In one study, conducted over eight months during the 2016 US presidential election, 34,000 people were shown a total of 49 online advertisements. The researchers found that these had an average effect on vote choice of 0.7 percentage points. In other words, just 7 people in every 1000 said they would change their vote after seeing these online adverts. Another study, published this year, showed that generative artificial intelligence could be used to design adverts tailored to personality types, with the resulting ads being rated as more persuasive when shown to people with the matched personality. However, the effect was once again minor – smaller than the variation between different adverts, and a lot smaller than the variation between different people.

Even without political campaigners attempting to manipulate what we see online, the algorithms behind social media feeds shape what individuals see and how they are encouraged to react. Other studies have looked at the impact this might have: for instance, researchers working with Facebook and Instagram examined the effect on users of seeing either the algorithmically determined feed or a chronological timeline during the 2020 US presidential election. The results showed clear differences in the content that users experienced and how they reacted: those with the chronological feed saw more political and untrustworthy content and spent less time on the platforms. Nevertheless, over three months, these differences didn't drive any changes in levels of polarisation or political knowledge. Again, this indicates that online effects can be smaller than the hype suggests.

Other research has looked at the potential for online advertising to influence voter turnout. One study found that personality-profiled advertisements resulted in significantly higher voting intentions than generic ones. But real-world studies suggest this effect is small too. One, for example, looked at the impact of a digital advertising campaign designed to persuade people to vote against Donald Trump and for Joe Biden in the run-up to the 2020 US presidential election. Conducted with 2 million voters in five battleground states, the study found that these adverts increased voting among Biden leaners by 0.4 percentage points and decreased voting among Trump leaners by even less – just 0.3 percentage points.

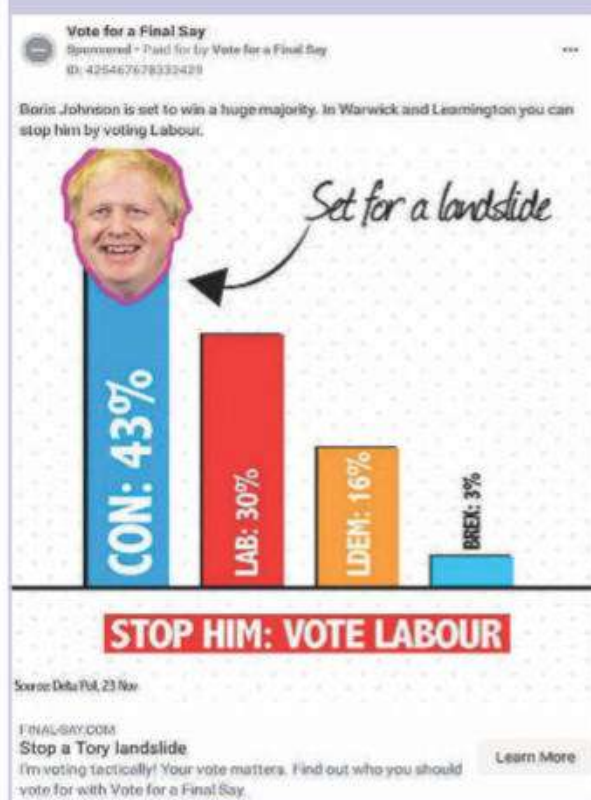
It could be argued that because elections are often tight, these small effects might really

Influence versus manipulation

Philosophers have spilled a lot of ink arguing about what defines manipulation. A core feature is deception – that the persuader hides either their true motive or something else about the persuasive message. This should immediately tell us that manipulation is a matter of degree, because even the most honest person can't tell you everything about their intentions or what they know and when. And even the most honest person will sometimes try to persuade you of something. That doesn't mean they are manipulating you.

A simple example illustrates this. Imagine you offer a crowd of 100 people an apple. You would probably get some takers. But that isn't manipulation: it is likely that the people you persuaded already liked apples or were getting peckish or both. It would be misleading to claim this as evidence that you were able to control people's minds. Likewise, an experiment finding that online ads affect people's vote choice doesn't necessarily prove that digital advertisers manipulate voters.

Online political ads can affect voting choices, but by how much?



KATHARINE DOMMETT ET AL. (2024)

matter, especially in the extremely marginal seats where we are likely to see the most intense campaign activity. However, it is useful to compare what we know about the effects of digital ads relative to other forms of electoral messaging. Research looking at the impact of door knocking or phone canvassing has shown larger effects, particularly when it comes to persuading someone to turn out to vote. In one analysis of several studies, face-to-face conversation was found to boost turnout by 2.5 per cent, and phone calls from volunteers had a 1.9 per cent effect. Digital ads therefore have a smaller impact than more familiar communication methods.

Hard to influence

These results help shed light on the threat posed by digital campaigning. Voters aren't routinely being targeted in a sophisticated way. When they do see campaign messages, they are hard to influence, and digital political advertising is less persuasive than more established forms of communication. But even small effects could be concerning. So, how worried should we be?

For a start, we need to be sure we are diagnosing the problem correctly. If we view all the research showing that digital campaigning has an influence as evidence of manipulation, it makes the monsters seem scarier than they are (see "Influence versus manipulation", left). In our view, targeting information at individuals alone isn't manipulative. Say I am advertising apples and I tell a health-conscious person that apples are a nutritious snack, and I inform an appearance-conscious person that they contain vitamins required for beautiful skin. If they then both buy an apple, it doesn't mean I tricked either of them into doing something they didn't choose, nor does it mean I can make anyone buy an apple any time I want.

But we don't always see digital persuasion clearly. Each of us holds our opinions, especially on political matters, and these affect our openness to new information. Those with right-wing views are less open to left-wing campaign messages and vice versa. Often people label the tactics and techniques used by their political opponents as manipulative, but are happy with their own party's behaviour. This inflates the number of accusations of campaigns being manipulative without meaning that more manipulation is necessarily happening.

So, we need to be clear about whether technology is actually having concerning effects or if it only has the potential to do so. The findings we have outlined provide some



intentions and turnout. We know less about the effect of advertisements on fuelling cynicism and disengagement from democracy in general. More research is required to assess the effectiveness of efforts to spread disenchantment or sow confusion online. We also don't know enough about how to tackle misinformation. Although studies indicate that its prevalence and persuasiveness have been overstated, the solutions touted by some catastrophists are simplistic: it can't just be censored away, designed out or easily inoculated against.

It would be wrong not to worry about the effect of digital tools on democracy, but it would also be wrong to panic. There are undoubtedly some problematic and concerning practices. What's more, the future is uncertain: just as microtargeting unleashed a new wave of concerns a decade ago, now AI is seen to pose a novel and dangerous threat to democracy. But we must be clearer about the precise problem before we pass judgement on its societal effects.

Besides, digital tools can also be used for good. Democracy is founded on the idea that voters should be informed and that there should be competition between campaigners with differing visions for the future. The use of digital technology to advance these goals is entirely compatible with a healthy democracy. And it does do this. For instance, research published this year found that US voters who agreed to have their Facebook and Instagram accounts deactivated six weeks before the 2020 presidential election read less news and were less informed, but were no less polarised in their views than those who kept scrolling social media – revealing the value of digital platforms for informing as well as misinforming.

Looking closer at what is happening has convinced us to be less worried about the digital future of democracy. People are harder to trick than we tend to assume. Psychological research indicates that they are also surprisingly reasonable and rational. You may not like the choices your fellow citizens make, but they have their reasons. The real worry isn't digital propaganda, but that we stop believing in our compatriots and give up on democratic persuasion altogether. ■



Kate Dommett is a professor of digital politics and Tom Stafford is a professor of cognitive science. Both are at the University of Sheffield, UK

comfort here – but research in this area also offers lessons. One is that people often view new technologies as more worrying in principle than in reality. Our own research highlights this gap. For example, in one study, we asked 1881 UK voters about every single political advert placed by parties, candidates and non-party campaigners on Facebook during the 2019 general election. Most were deemed broadly acceptable, with just 40 out of 2506 adverts judged to be “definitely unacceptable” by all respondents.

We also know that individuals' reactions to digital persuasion vary. People tend to be good at interpreting information from known sources, but aren't necessarily as savvy when it comes to unknown ones. Moreover, there is research suggesting that some people are more open to political advertisements from unknown sources, which could make them more susceptible to manipulation.

There are also aspects of digital democracy that we need to understand better. Existing studies have focused mainly on voting

“Digital ads have a smaller impact than door knocking or phone canvassing”



'Certain landscapes, flowers and trees are better for our health than others'

We are starting to understand exactly why the sights, smells and feel of the natural world are so good for us.

Kathy Willis tells Kate Douglas how to reap the benefits

WE ALL know that being in nature is good for our health and mental well-being. But how does it work its magic? For example, what explains the finding that, following gall bladder surgery, people who could see a verdant scene from their hospital window recovered three times faster and needed far less pain medication than those who only looked out over a brick wall?

It is this puzzle that led botanist Kathy Willis on a recent mission. The former director of science at the Royal Botanic Gardens, Kew, in London and current professor of biodiversity at St Edmund Hall, University of Oxford, says that what she discovered has changed her life. In her new book, *Good Nature*, she explores the growing body of research revealing what happens in our brains and bodies when we interact with nature. We tend to see ourselves as a visual species, but it turns out that the benefits we get via other senses – smell, sound, touch and a mysterious “hidden sense” – are just as impressive, sometimes more so. There is still lots more to discover, but, as she tells *New Scientist*, we have already learned plenty that can improve our lives.

Kate Douglas: What happens when we look at nature?
Kathy Willis: It induces different pathways

in our bodies. Our heart rate and blood pressure fall, stress hormones like adrenalin decrease and our brainwave activity is heightened in areas showing we are calmer and more clear-minded.

Are there certain “natural” colours we should seek out?

When you look at these physiological markers of calmness, it's green-and-white leaves, and yellow or white flowers that have the most pronounced effect. But a Czech study of more than 2000 people found that they preferred to look at radially symmetrical flowers and flowers that were blue. We don't know what effect their shape has on our physiology, but that study shows that our preferences don't always tell us what's best for us in terms of physical or mental well-being.

What is the best kind of landscape to view?

It is an open one with a few scattered trees. This makes us physiologically and psychologically calmer and there are two reasons for this. First, it detracts from your focused attention: it's more of a general background attention, so it gives you a sort of mental mini-break.

Second, when we look at something, our eyes pick up the complexity of the scene. We call this its fractal dimension, which is



"To maximise the benefits, you need to spend 120 minutes in nature each week"

ZORAN MILICH/GETTY IMAGES



Greater biodiversity in cities may improve residents' microbiomes

a measure of complexity that indicates the degree to which objects fill the available space. We prefer landscapes with mid fractal complexity. This is equivalent to a more open kind of landscape with a few trees.

These landscapes result in a particular brainwave response – heightened alpha and beta frequencies and reduced delta frequencies – which studies have shown are associated with increased focus and a feeling of calm.

You argue that smelling nature is even more beneficial than seeing it. Why?

Smell was a completely unknown sense to me. I mean, flowers smell nice, but I didn't think about it. I didn't realise that when you breathe in a plant scent, it passes across your lung membrane and some of those molecules pass into your blood. Many scents are now being shown to affect biochemical pathways in the same way as a prescription drug. And they can have long-lasting effects.

Which smells have known health benefits?

Lavender calms you down: it contains a volatile chemical called linalool, which has anti-anxiety effects. Then there's pinene, the predominant piney smell you get in a pine forest, which also reduces stress.

Another interesting one is plants in the cypress family, like cedar and juniper, which contain compounds called sesquiterpenoids. People who breathe those in have increased activity in the parasympathetic nervous system, indicating relaxation, but also reduced adrenalin and elevated natural killer cells – the immune cells that attack cancers and viruses. Limonene is another example: it's found in lots of citrus fruits and is an important anti-inflammatory molecule.

What about natural sounds? Are they good for us too?

Sounds have been shown to calm us. And there's a big meta-analysis which found that particular sounds are good for certain things. Birdsong, for example, is best at reducing physiological symptoms of stress, whereas water sounds improve mood and cognitive performance. But there are bad sounds, too: the harsh squawking of a crow or a parrot, that does not relax us.

The other really nice work on sound is in pain relief. Scientists in Japan, for example, have shown that people who heard nature sounds while having an operation with epidural anaesthesia had lower levels of a stress-related enzyme indicative of pain than others who listened to no sound.

Would you recommend tree hugging?

Unfortunately, nobody has studied tree hugging, but there is research showing that when you touch wood it lowers your blood pressure compared to stroking other materials. And different types of wood elicit different responses, which is possibly to do with their structure. But it's not just your hands: if your feet touch wood, it can make you calmer. There are also studies with schoolchildren, comparing playing a game of planting plants on a smartphone and actually planting plants in the classroom. The children performed better academically after touching the real plants and they also said that they felt calmer and happier.

In your book, you talk about a hidden sense.

What is that?

It's something you can't see, smell, hear or touch. It's all the bacteria and viruses and living things in the atmosphere around us – the environmental microbiome. The more biodiverse an area, the higher the level of diversity of the environmental microbiome. It's significant because, as we have lost diversity in our own microbiome, we have seen a large increase in many non-communicable diseases like asthma and also allergies, and the so-called biodiversity hypothesis says that we



LEN WILCOX/ALAMY

can increase it by spending time in and around naturally biodiverse environments.

Sure enough, research shows that after 14 days of playing in a playground of soil from a boreal forest, preschool children had effectively adopted the signature of the soil's microbiome on their skin and in their gut. And they had fewer inflammatory markers in their blood, indicating an enhanced immune system. The same thing has been found in adults. For example, people who had a green wall in their office for 28 days had more good bacteria on their skin and in their gut, and greatly reduced inflammatory markers in their blood.

When it comes to spending time in nature, what's the best medicine – and what dose should we aim for?

To maximise the benefits, you need to spend at least 20 minutes at a time in nature, and at least 120 minutes each week. If you're going out walking, walk in the park rather than on the streets. There's a huge difference to what it does for you. The second thing is to seek out areas that will stack the benefits of nature. Go to a copse where you can hear the birds – one that is as far away as possible from the road and its unhealthy sounds. Go where you can smell the air, where there are scented plants like lavender and rosemary. Now, I always choose conifers if I can because pine smells are so good for you – but I avoid dense tree cover because there is evidence that can stress you out.

What about gardening?

Gardening has huge benefits because you're combining so many of your senses: sight, sound, smell and, by touching the soil, you're getting that environmental microbiome into your body. But there are some surprising studies. First, you get greater benefits from putting pretty flowers in pots in your front garden than in the back. I think that's because you're walking through it all the time. So, concreting over your front garden is probably the worst thing you can do. Also, research has shown that people report greater calming



WAVEBREAK MEDIA PREMIUM/ALAMY

Above: Green spaces around hospitals can accelerate people's recovery from operations.

Left: Children feel happier and perform better academically after gardening

and other health benefits from gardening in an allotment than in their private garden. It might have something to do with community cohesion, but also, with an allotment, you're planting a whole variety of shapes, sizes and colours and it goes on all year round.

How should we change our homes and offices to make the most of these findings?

In my home office, I've got a bottle of hinoki oil [from a species of cypress tree] that I diffuse every couple of days because it increases natural killer cells. I have a green-and-white spider plant. In fact, I have plants all around me now. That's sight and smell. We can do sound too, with recordings of nature, and touch by increasing the amount of natural, untreated wood around us. We can also take mental mini-breaks: look out of the window onto greenery.

And how can we improve public buildings like schools and hospitals?

Schools are most important to me because it's not just about physical and mental well-being, but also cognitive performance. Children do better academically when they have green walls to look out onto or in the classroom. Many schools are looking to put more shade structures in their playgrounds – often big canvas things with metal poles. Well, of course,

the alternative is to plant some trees or even some ivy up a wall. And you'll stack the benefits you get from nature by doing that as well as providing the shade you need.

As for hospitals, work really needs to be done to demonstrate that prescribing nature is as cost-effective and effective in terms of treatment as prescription drugs. There is evidence coming through to support this. We're not at the point where we can argue the economic case, but that's where we need to be if we really want the National Health Service within the UK to adopt this. It is already happening in some places, though. I went to Singapore recently, and they now have a centre for biodiversity medicine in their hospital.

Do we need to rethink urban green spaces?

Absolutely! The implications are huge. We need to build more houses and that is putting big pressure on urban green spaces. People often think that it's OK for a developer who destroys biodiversity to create it elsewhere. But we absolutely need to have biodiversity around us in cities. You can't move it somewhere else and hope it's going to give the same benefits. More biodiversity in cities is good for nature – but it's critical for our well-being. ■

Kate Douglas is a features editor at *New Scientist*

Puzzles

Try our crossword, quick quiz and logic puzzle **p45**

Almost the last word

How do I know if what I see is actually there? **p46**

Tom Gauld for *New Scientist*

A cartoonist's take on the world **p47**

Feedback

Broccoli deception, Venn masters and non-stick diets **p48**

Twisteddoodles for *New Scientist*

Picturing the lighter side of life **p48**

Dear David

Having a laugh

A reader is concerned her laughter is damaging her credibility at work. Advice columnist **David Robson** looks into the science



David Robson is an award-winning science writer and author of *The Laws of Connection: 13 social strategies that will transform your life*

Resources

If you find yourself troubled by others' laughter, you may consider treatment for your "gelotophobia" – a fear of being laughed at – as this article from the British Psychological Society describes: bps.org.uk/psychologist/fearing-laughter

"ONE of my colleagues has pointed out that I laugh a lot, even when no one's joking," a reader writes. "I'd never really noticed this before, but his comments have made me worry that my laughter is damaging my credibility at work."

No, this reader isn't Kamala Harris, though I can't help wonder if she has been inspired by the discourse around the Veep's habit of chuckling her way through interviews. Titles like *The New York Times* and *The Atlantic* have speculated about the impact this may have on her presidential campaign, but what does science have to say?

Let's first address our reader's worry about the appropriateness of her behaviour. One analysis of 70 hours of recorded meetings suggests that laughter comprises around 10 per cent of our vocalisations in conversations. This will vary from person to person, but it might be considered unnatural – or "weird" – not to laugh regularly in a working day.

According to an idea developed by Adrienne Wood and Paula Niedenthal, then both at the University of Wisconsin-Madison, our laughter has three main functions. The first is reward: it signals our appreciation of the other person and helps reinforce the behaviour they have just performed.

The second is affiliation: a laugh can help smooth over any potential awkwardness in a conversation and demonstrate our wish to keep it playful. It shows we don't wish to be seen as a threat.



JOEFF DAVIS/SHUTTERSTOCK

The third motive is dominance. By using this non-verbal cue, we can signal our disapproval without engaging in an open confrontation. It may not be taken kindly, but it might avoid the fight that could arise if we put our feelings into words.

These distinctions are critical when we consider concerns about the appropriateness of our laughter, particularly if we are in a position of power. In a recent paper, David Cheng at the Australian National University and his colleagues asked participants to watch leaders counter difficult interview questions. They found that perceptions of the leaders' laughter largely depended on how the questioners reacted. If they joined in the laughter, then it

enhanced the leader's perceived warmth, which in turn enhanced judgements of their effectiveness.

We can imagine here that the laughter was taken as a sign of affiliation. If the questioner didn't reciprocate, then the laughter diminished the leader's perceived warmth and effectiveness – it seems to have been interpreted as an attempt to assert dominance, which makes them less appealing.

Provided her intentions are benevolent and she is sensitive to reactions, I see no reason why our reader should curb her cackles. Let her colleagues live in stern solemnity: after all, she who laughs loudest, laughs longest. ■

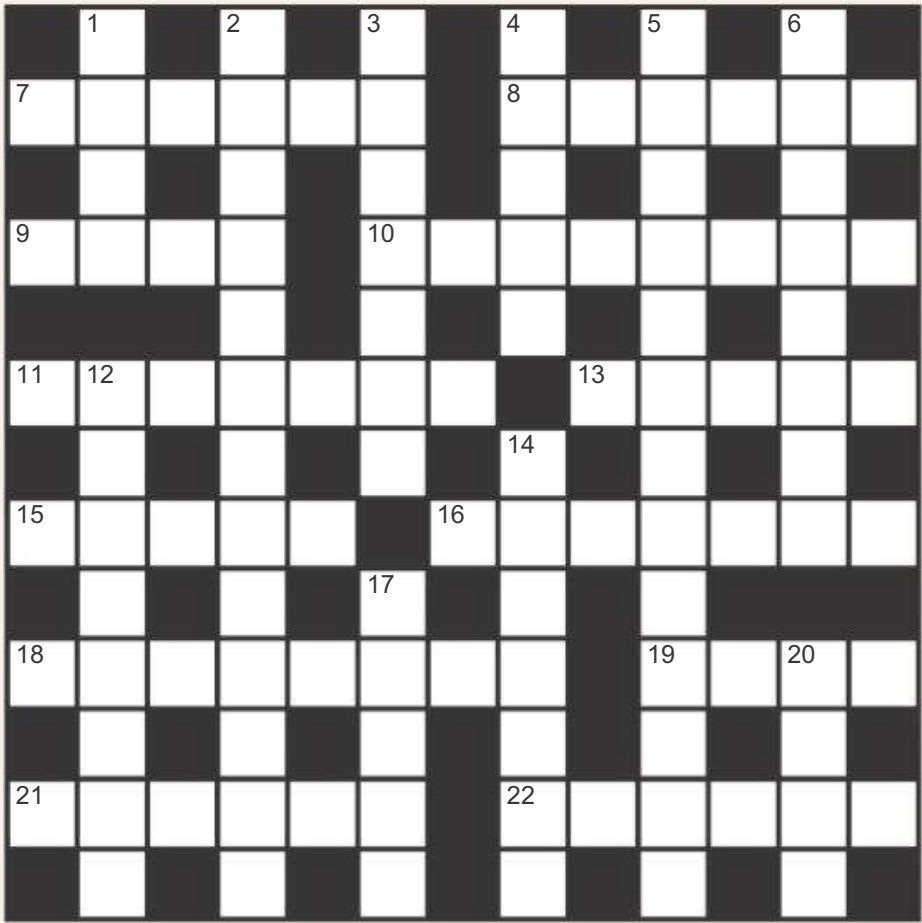
Dear David, an evidence-based advice column, appears monthly. Drop David a line with your social dilemmas at davidrobson.me/contact

Next week

Stargazing at home

These articles are posted each week at newscientist.com/maker

Cryptic crossword #143 *Set by Trurl*



Scribble zone

Answers and the next quick crossword next week

ACROSS

- 7** Happy, at first, with backstreet astronomer (6)
8 Job with a condition that may involve involuntary movement (6)
9 Crisis of '56 turned around by Olympian (4)
10 Head of microscopic rotifer tangled like a net (8)
11 Departs, mangled by explosives (7)
13 Daisy's head may be protected by this secure shell, buddy! (5)
15 Electron doublet contains alternating form (5)
16 We're told to continue providing food for crows (7)
18 Infectious disease in shopping centre – spokesperson's covering it (8)
19 Energy absorbed by light area in part of eye (4)
21 Mass given by time + disposition – height (6)
22 What lovelorn teen might want, as of right now (2,4)

DOWN

- 1** Swell to shake hands, perhaps (4)
2 Family of handbells rearranged, with martellato last and dampers first (5,3,5)
3 Stoned, baked (we hear it's got H in it) (7)
4 Angstrom pretty narrow! (5)
5 Joe's justification for waste (6,7)
6 Goya's ear removed, once upon a time (5,3)
12 Giant singer like Pavarotti a squeaker with note? (8)
14 Al's in here! Jack's having something to eat outside (7)
17 Seed seen in finals of tennis championship, despite shoulder problem (5)
20 Last words of Roman killed in capsized cutter (2,2)

Quick quiz #267

set by Bethan Ackerley

- 1** How long is the orbital period of the comet Tempel-Tuttle?
2 The production of sound by rubbing body parts together, such as a grasshopper's hind legs, is known as what?
3 What name is given to the leaf-shaped flap in the throat that prevents food and water entering the trachea and lungs?
4 Many millions of years ago, volcanic activity in what is now Siberia is thought to have led to which mass extinction event?
5 Which isotope has the longest known half-life for alpha-decay?

Answers on page 47

BrainTwister

set by Katie Steckles
#35 Cube cuts

Imagine a 3×3×3 cube (like a Rubik's cube) that can be cut into separate pieces along the lines between the 27 individual small cubes that make up the larger shape.

If we are allowed to cut through more than one piece of the whole cube at once (as if passing a 2D plane through the whole shape), what is the fewest number of cuts we need to create four separate pieces of any size?

To cut the whole cube up into its 27 individual small cubes, we can make six cuts (two in each of the three directions). Convince yourself that this can't be done in fewer than six, even if we are allowed to move pieces between cuts.

If, instead, you are only allowed to make cuts to one piece at a time – that is, taking one of the pieces each time and making a single cut that goes all the way through it – what is the fewest number of cuts you will need to separate the whole cube into its 27 individual cubes?

Solution next week



Our crosswords are now solvable online
[newscientist.com/crosswords](https://www.newscientist.com/crosswords)

Seeing is believing

How do I know if what I see is actually there?

Garry Trethewey

Arkaroola, South Australia

This is a pretty big question for lots of 50-year-olds, let alone for our 10-year-old questioner. There are whole areas of philosophy and neuropsychology as well as other arcane fields devoted to this.

Basically, you can't know if what you see is actually there.

You might be hallucinating or under the influence of drugs, or have a brain tumour. You might actually be a green lizard on Mars, under the influence of a magician, who makes you believe you are an Earthling, writing to a make-believe thing called *New Scientist*.

In more plausible scenarios, your perceptions can be affected by a persuasive story, strong emotions or sensory overload.

That's why, when confronted with something amazing, wise people keep an eye on how their own brain works before they act on what's "out there".

Pat French

Longdon-upon-Tern, Shropshire, UK

This question has been asked for thousands of years. Socrates asked something very similar nearly 2500 years ago.

"You might be a green lizard on Mars under the influence of a magician, who makes you believe you are an Earthling"

I am afraid that you can't know if what you are seeing is there. No one can. Also you can't know that what you are seeing is the same as what I am seeing, even when we are looking at the same thing.

It is a wonderful thought that the whole universe as you experience it is created by your own brain. It might be very different from the universe that another person lives in.



PLAINPICTURE/MIA TAKAHARA

This week's new questions

Equally speedy How do we know that gravity has the same speed as light? And why is this the case? *Jonas Hermansson, Brösarp, Sweden*

Caught in a trap My humane mousetrap's instructions tell me to release my visitor a mile away or it may find its way back. Can this be true? *Julia Bevan, Nuneaton, Warwickshire, UK*

We have learned to use shared words and language for the things that we alone see.

When we look at something, there is probably something there, but its form is out of our reach. We can only sense it with the tools that we have: eyes, nose, tongue, ears, skin and a few others. They paint the picture that each of us calls reality.

Each of those tools generates electric impulses that run along our nerves to our brain. Those impulses have no colour, smell, taste, sound, temperature or "feel". The brain only knows that a particular impulse was generated by a particular sensor, whether it was in the eye, nose or skin.

It is our individual brain that interprets those electric impulses into the sensations,

sights, sounds and feelings that we call reality.

Most of what we perceive as solid "stuff" made of atoms isn't there at all. If the nucleus of an atom were expanded to be the size of a football and placed in the middle of a sports stadium, its closest electron would be buzzing around the back rows of the stands. Everything between would be vacuum, nothing.

Science is working hard to find out what reality is. Along the way, it has a second job that is nearly as hard. It has to turn the measurements, the mathematics, the invisible particles and the invisible forces into some image or description we can understand with our basic tools: eyes, nose, tongue, ears and skin.

How is it we know that the speed of gravity is identical to that of light?

For some of us, *New Scientist* magazine is part of that process.

Gerard Buzolic

Coolum Beach, Queensland, Australia

This is a delightful take on the question "Are we living in a simulation?", which is "Is all this really there?" with an extra bit added, "Am I really here?" The computer imagining me, if there is one, has somehow given me a sense I exist. To be able to do that, it would have to be a computer like nothing we know of.

Drugs and alcohol mess with people's minds and can sometimes make them see things that aren't actually there. Dehydration and certain mental health conditions can have similar effects. Pink elephants may seem real to the person experiencing a hallucination, but no one else sees them. The one person who thinks they are actually there is outvoted by the 100 who say they aren't.

I shall go with my idea that others exist and they have minds like mine, and go with the majority who describe what we see with consistency. If everyone described reality differently – perhaps, if some people said they could fly but others said they couldn't, or if some people said the sky was the colour of a ripe tomato – then I would suspect that no one really knows. But our science is consistent. One scientist measures something and another scientist gets more or less the same result if they measure the same thing and use the same method. So I shall go with "it is actually there".

Philip Sugarman

Northampton, Northamptonshire, UK

Valid ways to check are to look again from another angle, go over and touch it, examine a map, take a photo, ask someone or google it. If these don't satisfy you, maybe a career in philosophy will.



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Tom Gauld
for New Scientist



Whodunnit?

If visitors to our planet in millions of years found fossils of a *Homo sapiens* and another great ape in an elaborate tomb, would they be able to prove which one built it? (cont.)

Allen Wright

Penzance, Cornwall, UK

New Scientist often has articles about proto-hominoid species and these seem to provoke a good deal of interest. The latest discoveries about the Denisovans shows that archaeologists have the ability to recognise which human groups and species were associated with which sites.

The interesting question is whether the alien visitors would have any kind of sociocultural interest in archaeology or whether their societal ethos would be focused purely on advancement – although can you advance without knowledge of your past?

If the visitors do have an interest in archaeology, then I would presume they would recognise the importance of

“Such a burial site might even become an intergalactic tourism hotspot, as visitors race around sites to discover themselves”

a site that seemed to contain multiple species using it in a religious manner. It might be that such an inter-species site becomes noted as a galactic anomaly. It might prove to be a vital planetary social evolutionary moment – the moment when a second species achieves ritualised cultural practice and something all advanced planets go through on their way to becoming spacefaring, ready to deal with aliens as equals and not as competitors.

Such a site might even become a tourism hotspot, as visitors race around intergalactic landmarks to discover themselves.

Luce Gilmore

Cambridge, UK

Abhranil Dasgupta's answer (20 July) emphasises the intuitive,

mental and spiritual powers that we might expect from a civilisation with a technology capable of crossing interstellar distances. I beg to differ.

Our own species' technological advances have been accompanied by a rise in materialism: Charles Darwin's *On the Origin of Species* was excoriated, not for promoting evolution, which has been a respectable stance since ancient Greece at least, but for its materialist explanatory basis.

As a materialist, I would examine the *Homo sapiens* fossil and the *Pan* or *Gorilla* fossil, say, in the tomb and observe that the latter fossil has demonstrably less agile and weaker hand grips: almost the only feature where *Homo sapiens* is the stronger. Even more telling, *Homo sapiens'* feet, ankles, legs and hips are far, far better adapted to walking.

If the elaborate tomb had stairs (as most do) without handrails (bathetic in grandiose funerary fittings), then *Pan* or *Gorilla*-originated architecture could be ruled out. ■

Answers

Quick quiz #267 Answers

- 1 33 years
- 2 Stridulation
- 3 The epiglottis
- 4 The End-Permian extinction event, which is also known as the Permian-Triassic extinction event or the Great Dying
- 5 Bismuth-209

Quick crossword #165 Answers

ACROSS 1 Nipple, 4 Emotions, 9 Brahe, 10 Milligram, 11 Lakh, 12 Otis, 13 Horse, 15 Ufology, 16 Oval, 19 Zone, 20 Epitaxy, 23 Laser, 24 Ears, 25 Wiki, 27 Autopilot, 28 Oiled, 29 Honeydew, 30 Eraser

DOWN 1 Nobelium, 2 Plankton, 3 Leek, 5 Millstone-grit, 6 Trichiasis, 7 Orrery, 8 Semtex, 10 Methylene blue, 14 Tomography, 17 *Bacillus*, 18 Cylinder, 21 Bleach, 22 Isatin, 26 Four

#34 Square dealing Solution

After the famous $3^2 + 4^2 = 5^2$ Pythagorean triple, the next sequence is $10^2 + 11^2 + 12^2 = 13^2 + 14^2$, so the value of d is 10. The starting numbers follow the pattern 1×3 , 2×5 , 3×7 , 4×9 . They are all triangular numbers, skipping every second one ($1+2$, $1+2+3+4$, $1+2+3+4+5+6$).

The fifth sequence, of 11 numbers, starts with $5 \times 11 = 55$, that is: $55^2 + 56^2 + 57^2 + 58^2 + 59^2 + 60^2 = 61^2 + 62^2 + 63^2 + 64^2 + 65^2$.

Bold as brassica

What would be the effect on young adults and young children of seeing positive expressions on the faces of strangers who are eating raw broccoli?

Katie Edwards at Aston University, UK, together with colleagues there and at the University of Birmingham, also in the UK, tried to find out.

The journal *Appetite* published a first-hand account of that adventure, along with the title "Exposure to models' positive facial expressions whilst eating a raw vegetable increases children's acceptance and consumption of the modelled vegetable".

No need to mince words or broccoli about what they found. In their words: "contrary to the hypotheses, models' facial expressions whilst eating broccoli did not significantly influence initial willingness to try broccoli".

Circles of life

In the 1960s, young intellectuals in Western countries urged each other to adopt the philosophy and ways of Zen (Zen Buddhism). To have a thoughtful, wise, good life, people were encouraged to "go the ways of Zen" and to "be at one with the universe".

Six decades later, thoughts and chatter have advanced.

Although no replacement has been widely adopted in the West as a counterpart in the 2020s, Feedback suggests Venn (Venn diagrams).

Venn, like Zen, aims for a simpler understanding of matters that seem complex. Venn masters sometimes describe their practice this way: a Venn diagram uses overlapping circles or similar shapes to illustrate the logical relationships between different kinds of items.

Adopt the philosophy and ways of Venn. Perceive and cultivate the overlaps in your life. Draw a Venn diagram of the qualities of every person, place and thing from your entire life, from birth

Twisteddoodles for New Scientist



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until now. The overlaps in the Venn diagram will reveal the commonalities. Embrace them. Be at one with the few.

Go Venn.

Talent for titration

Superpowers, trivial or otherwise, have the reputation of being all or nothing. John Hancock tells Feedback of an exception – maybe a partial exception – to that.

He says: "It seems I am able, consistently, to pour out almost exactly half of a 339 ml bottle of beer, such that 2 identical glasses have the same level of beer within 1 or, at most, 2 mm. This is done in one pour without any aids – I just seem to know when to stop pouring!"

(Feedback notes that Hancock's name is familiar to citizens of the US. On 4 January 1776, a previous

John Hancock signed the Declaration of Independence, a document that told Britain to go suck eggs. That Hancock wrote in lettering so big and bold that his name became a synonym for "a person's handwritten signature". In the US, people still tell each other to "sign your John Hancock". That earlier John Hancock, unlike this current John Hancock, disdained half measures.)

Questionable discomfort

There is another recent addition to Feedback's collection called The Title Tells You Everything You Need to Know.

"The possible pain experienced during execution by different methods" perhaps brought surprise to readers of the journal *Perception* in 1993. It also won the 1997 Ig Nobel peace prize for its

author, Harold Hillman at the University of Surrey, UK.

If you find an equally striking example, please send it, with citation details, to Telltale titles, c/o Feedback.

The Teflon diet

Teflon, much appreciated as a "non-stick" coating on frying pans and other cookware, could become an everyday additive to food, especially in weight-control diets.

Readers of a 2022 study called "Engineering properties of Teflon derived blends and composites: A review" get a quick hint of that in a single, slightly cryptic sentence: "By volume of Teflon reduced calories in food and observed satisfactory results accepted by community". That sentence refers to a paper published in 2016 in the *Journal of Diabetes Science and Technology*.

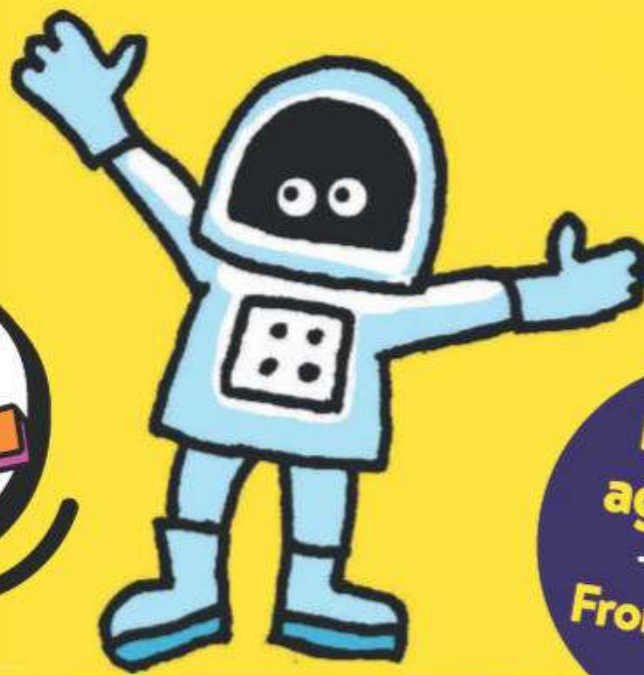
The 2016 paper has an intellectually yummy title: "Polytetrafluoroethylene ingestion as a way to increase food volume and hence satiety without increasing calorie content". The authors, Rotem Naftalovich, Daniel Naftalovich and Frank Greenway, in the US, explain that polytetrafluoroethylene – also known as PTFE or Teflon – is a plastic. They propound its merits: "Animal feeding trials showed that rats fed a diet of 25% PTFE for 90 days had no signs of toxicity and that the rats lost weight."

They go on to hypothesise "that increasing the volume of food by mixing the food with PTFE powder at a ratio of 3 parts food to 1 part PTFE by volume will substantially improve satiety and reduce caloric consumption in people".

Polytetrafluoroethylene, they write, "contributes no flavor (evident by its use in tongue piercings) and hence does not detract from the eating experience". It is also "extremely inert... so it will not react within the body".

It is thus "an ideal material for use as a nonmetabolized food volume bulking agent" – and in food that definitely won't stick to your ribs. ■

Marc Abrahams



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